HOW THE WORLD IS CLOTHED

READERS ON COMMERCE AND INDUSTRY

HOW THE WORLD IS CLOTHED

BY

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FRANK G. CARPENTER

Introduction to Geography

AROUND THE WORLD WITH THE CHILDREN

Geographical Readers

NORTH AMERICA

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Readers on Commerce and Industry

HOW THE WORLD IS FED

HOW THE WORLD IS CLOTHED

HOW THE WORLD IS HOUSED

CARP. WORLD IS CLOTHED.

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PREFACE

"HOW THE WORLD IS CLOTHED" is the second volume of a series of school readers intended to give a personal and living knowledge of the great world of commerce and industry. In "How the World is Fed" the children, accompanied by the author, visited the great food centers and saw for themselves how the chief food staples are produced and prepared for use. In "How the World is Clothed" they travel in the same way over the globe investigating the sources of their clothing. The journeys are along geographical lines, and while studying the industries the children are learning about localities, trade routes, and the other features of transportation and commerce.

In these travels the personal element is never absent. The children themselves make the imaginary journeys, and that to learn about the clothing they themselves are wearing, and about articles which are necessary to their own comfort and pleasure.

The author advises that this personal feature be stimulated, as far as possible, by having the pupils bring into the class room specimens of the various clothing materials, as the chapters relating to them are read. For instance, in the study of cotton, a cotton boll with the seeds in it or even a bit of cotton wool and some cotton cloth will make the subject a live one.

The plan of the book is a simple one. The children start out first to those parts of the world which produce the vegetable fibers of commerce. In our Southern States they learn how cotton is raised; and, traveling with the white lint to the great factories, watch it made into the cloth which they wear and use every day. They next take up flax, hemp, and jute, and visit the localities where

they are grown. This carries them over a great part of Europe; to China, Japan, and the East Indies; and to various parts of North and South America as well. In the wilds of Africa they see how the natives dress in a bark which they raise in their gardens, and in the Philippine Islands watch their little brown cousins raising Manila hemp.

Another series of journeys is devoted to the animal fibers. The children visit the great sheep-rearing regions of Australasia, Argentina, and our own country to learn about wool. They go to China, Japan, and southern Europe to watch the spinning of the silkworms, and they travel with the raw silk to New York. They enter the woolen mills and silk factories, and observe for themselves the processes of spinning, weaving, and dyeing.

Their travels in the leather lands show them where the material for their shoes comes from. In the Amazon Valley they learn about rubber, and in the cold lands along the Arctic Ocean they themselves hunt the wild animals which furnish our furs. This plan is followed as to every other article which forms a part of their clothing, including feathers and jewels, needles and pins.

It is believed that such imaginary travels will be valuable; not only for teaching the children about the industries described, but also in the giving them a live geographical knowledge which cannot be imparted by the ordinary text-book.

Special thanks for courteous assistance rendered in securing material for many of the illustrations are due to Messrs. John C. Wilson & Co., manufacturers of hats; William Barthman, manufacturing jeweler; Crossman Company, dealers in pearls; Alfred H. Smith, dealer in precious stones; Jacob Adler & Co., manufacturers of gloves; Singer Sewing Machine Co.

CONTENTS

HOW THE WORLD IS CLOTHED

I. INTRODUCTION

IN this book we are to travel together among many strange peoples in different parts of the globe. We are starting out on a long tour through the great world of commerce and industry to learn how man is clothed. We must find out, not only how the various nations and tribes clothe themselves, but what clothing materials they make and sell to other nations and what they take in exchange. We want to know where our own clothing comes from, and to see the men, women, and children who are producing the materials of which it is composed. We should like to go along with the materials to our factories and see them made into the garments we wear. This is a great undertaking, and it will require many thousand miles of travel.

Take the suits we have on to-day. Let us imagine some of the places from which they may have come. The felt of that boy's hat contains fur which last year was warming a rabbit, shot last winter in the wilds of northern Canada. His shoes came from the sides of a cow that was then grazing upon the plains of Argentina, and his woolen suit from the back of a sheep that very likely fed along the edges of the Australian Desert. Those pearl buttons on his shirt were once parts of the houses of

oysters in the waters off the Philippine Islands, and the buttons upon his coat were kernels of vegetable ivory nuts on a South American palm tree. The cotton of his shirt came from cotton plants grown in our Southern States; and the linen of its collar was once in a flax field in Belgium or Ireland.

And then, the clothes which the girls of our party are wearing! We shall have to travel halfway around the world to reach the places whence they came. If those gay silk hair ribbons could speak, they might say that their lives began in the bodies of silkworms, tended by yellow-skinned women and children on the other side of the globe. If the hats knew our language, they might tell how the straw in them grew on the shores of Japan, and was gathered by other cream-colored mortals; and, at the same time, the bright feathers that decorate them might whisper that they formed the tails of birds which the brown Papuans chased through the wilds of New Guinea. The alpaca of Lucy's fine gown could give us stories of the high plateau of the Andes, and the mohair of Susie's dress might tell us tales of the goats of Angora, in Turkey, south of the Black Sea. The leather of her shoes might squeak of its life on the back of a kid on the edge of the Desert of Sahara; and the rubbers, that keep the leather dry, could tell of the Indians who gathered it as the sap of trees on the banks of the Amazon River. Every girl of our party has articles upon her which began their existence far, far away; and if one of our boys were to travel back to all the places from which the things he is now wearing came, he would be many, many months on the road.

If we should start out to follow these materials on their wanderings to us, our travels would be much greater still. We should have to trail the Indian, who trapped the rabbit, to the trader who bought its skin and sent it to the great hat factory; and we should have to go there to see the fur felted and molded into shape. Supposing our shoes came from South American hides, we might go beyond the equator and follow them on their long sea trip along the Atlantic coast to our tanneries, where they are made into leather; and thence to our shoe factories, where the leather is cut, sewed, and nailed into foot gear. For our jackets, if the wool came from Australia, we should journey with it upon wagons or cars to the seaports, and thence over the oceans to the great weaving mills and on to the shops, where the goods are sewed into clothing.

In addition to all this, we should have many journeys in following the buttons, pins, and linings. All have had their adventures, and all have passed through many changes on their way here. Producing and gathering the materials, and manufacturing them into their various shapes, form some of the chief fields of the world's industry. Exchanging them and transporting them from place to place comprise an important part of its commerce. We wish to learn all we can about clothing as regards these two things; and we shall therefore call our journeys travels of industry and commerce.

We shall first visit the places where the various clothing materials originate, and shall watch them on their way to the markets. Later we shall visit the factories and see the materials made into the clothing we wear.

2. THE EVOLUTION OF CLOTHING

HAVE you ever thought that, of all the animals of the world, man is the only one who provides himself with artificial clothing? Every other animal is born with a beautiful coat that fits it to perfection, protects it from the weather, is suited to its needs, and is continually being renewed. The dog, the horse, the sheep, the bird, and the wild animals which roam the forests — yes, even the flies, bees, and bugs, and the fishes and reptiles as well, are by nature their own spinners, weavers, and clothiers. Man alone finds that he must have other things, outside the skin he is born with, for comfort and ornamentation; and he calls on all the world to help him.

Indian boy clad in feathers, Brazil.

Indeed, we now consider the use of clothing a sign of civilization, and look upon it as one of the chief things that mark our superiority to the rest of the animal creation, and to such of the human race as are less clad than ourselves. There are to-day many tribes on different parts of the earth who still go more or less naked; but they are savages, and we shall find them living on the lowest scale of the world's civilization. I have seen some of these half-naked men in the islands off the southern end of the South American continent, upon branches of

the Amazon, and also in the wilds of Central Africa. These people are little better than beasts. They dwell in rude huts or in shelters made of the leaves and branches of trees. They feed upon roots and wild plants. Some of them eat grasshoppers, and insects and worms from the bark of trees, and others subsist largely upon the fish and the wild animals they catch. They have but little religion, and believe in witches and idols.

In the first ages of the world, it is supposed that every one went naked. Then, leaves and bark were used as a protection from the weather, and later, perhaps, furs of various kinds. Amongst the savages of to-day the Eskimos and others are clad in skins, and there are many tribes in Africa who wear clothing made from the inside bark of certain trees, which they grow in their gardens.

Fur-clad boy, southern Argentina.

It was probably some time before men learned that they could spin wool into threads to make cloth. But they did discover it, and to-day we find that the semi-savages in many parts of the world own sheep, and that they have rude ways of turning wool into cloth for their gowns and tents. This is so upon the little-known highlands of Asia, and in the wilder parts of the Desert of Sahara. Among civilized peoples the use of wool has so grown that in many countries, such as Argentina and Australia, sheep rearing has become one of the chief industries, and there are millions of people employed in

weaving wool for the garments of civilized man. Other animals besides sheep have been found to produce excellent wool. The hair of camels, goats, alpacas, llamas, and yaks is used for clothing, and even that of the beaver, rabbit, and coypu can be so worn.

As time went on, man learned that there were other animal fibers besides wool and hair that he could employ for this purpose. He found that the cocoon of the silkworm could be unwound, and its threads woven together, and that the worms could be reared for the cocoons.

Not very far along in his history, he discovered that there were certain plants and trees which contained fibers that might be used for clothes making. He learned that the soft silky lint, wrapped about the seeds in the cotton boll, was made of hollow hairs ranging in length from one half inch to two inches, and that these were of such a nature that they would easily combine together. He found that flax, hemp, jute, and some other plants have within their inner bark soft fibers, from ten to one hundred inches long, that can be used for weaving; and that certain great plants, like those which produce Manila and Sisal hemp, have many hard fibers, from one to ten feet in length, either in the leaves themselves or in their leaf steams. All these hard, soft, and lintlike fibers he has gradually learned to take out and weave into clothing.

Moreover, as time went on, man discovered more about weaving. He made woolen cloth before the dawn of history, and he was already weaving linen when the Pyramids were built. The Chinese say that it was the wife of one of their emperors, who lived more than thirty-five centuries

ago, who first found out how to make silk; and we believe that the weaving of cotton was discovered much later. The various processes of felting, by which our hats and certain kinds of cloths are made, are of comparatively recent origin, as is also the use of the sap of the rubber tree for wet-weather clothing. It is the same with the many things which are more or less employed in the different parts of our dress. The first pins were thorns, and the first needles were fish bones. From the use of strings and bits of wood, in connection with loops, came the button and the buttonhole, and man finally dived to the bottom of the seas and rivers to get the shells which make the most beautiful of our buttons.


Chinese children.

And so it continued, the knowledge of the art of making clothing increasing from age to age and from year to year, and the industry of producing it growing and spreading, until now almost every nation and tribe and nearly every part of the world is engaged in one form or another of clothes making.

As we journey from place to place, we shall be able to study every stage in the building up of this great industry, finding the savages of the wilds still wearing the scanty clothing of early ages, and those a little more advanced

making their garments according to the rude fashions that our ancestors followed. In the different countries we shall see how the materials are produced, and, in our great factories and workshops, how they are transformed into the garments sold in our stores.

3. COTTON

WE begin our travels this morning in the southern part of the United States. We are in the lower Mississippi Valley not far from the banks of the river, and in the heart of the cotton belt. For weeks we have been moving about through regions devoted to cotton. We started on our journey at the city of New York, and thence went *via* Washington into southern Virginia, where we saw our first cotton. We passed many large plantations as we journeyed on through North Carolina and South Carolina, and in certain portions of Georgia, Alabama, and Mississippi the land was almost all planted in cotton. This was especially so in Texas, which produces more of this crop than any other State, and also in this part of Mississippi, which yields some of the largest cotton crops of the world.

How interesting it is! As far as we can see are vast tracts of little bushes which seem to be blossoming out into snowballs. In the distance they are green, dusted with white. As we come nearer, we observe that each field is covered with green stalks that branch out into stems, at the ends of which are little round balls of green or opened balls of snow white. The balls are the cotton bolls; and the white, wrapped around the black seeds within them,

is the lint which forms the cotton of commerce. In some of the fields, negro men, women, and children are moving about among the stalks gathering the fleecy white stuff, and putting it into great bags and baskets. In others there are cotton-picking machines drawn by horses. Some machines are propelled by motors; they make a great noise as they rattle over the furrows.

"... gathering the fleecy white stuff."

Everywhere we go in this part of our country we find some form of the cotton industry. On the roads are huge wagons piled high with the white lint. They are drawn by mules, and are on their way to the gins, where the seeds will be taken out and the white wool left, fitted for spinning. We see men baling cotton, here and there; and at every station on the railroad are great bales, piled up for shipment. Long trains of cotton fly past us or stand on the side tracks, and, as we move along the banks of the

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rivers, we see steamboats so heavily loaded with cotton that they seem in danger of sinking.

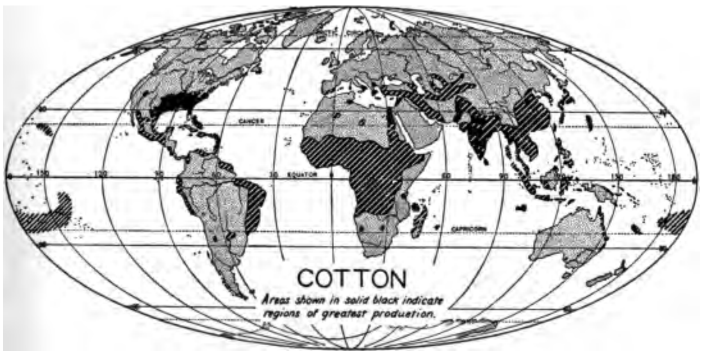
At the principal ports there are huge warehouses and cotton-pressing establishments, and the work of handling the crop goes busily on. Gangs of men are taking the bales from the cars into the ocean steamers which will transport them to Europe and to other parts of the world.

". . . huge wagons piled high with the white lint."

Other gangs are loading cotton on ships and cars for the mills of our own country, both in New England and our Southern States. We find such mills everywhere through the cotton belt, and see vast quantities of cotton goods, coming from them and starting out to clothe the men, women, and children of the far-away parts of the globe.

Have you ever considered how important the cotton plant is? About its little black seeds, no bigger than the

seeds of a lemon, is wrapped the clothing of half the world. More people are clad in cotton than in silk, wool, furs, skins, or anything else, and more, I dare say, than in all other things put together. Man uses two or three times as much cotton as wool; and so much is grown every year that, if it could all be collected and evenly divided, giving every one his share, there would be more than four pounds for every man, woman, and child upon the earth and there would be many million pounds to spare.



"The greater part of the world's cotton comes from the United States."

The greater part of the world's cotton comes from the United States. This vast region, through which we have been traveling, has a soil and climate so well suited to this crop, that we produce more than three fourths of all that is grown. If we could follow our raw cotton to the factories, and thence on, in the shape of cloth, to the people who wear it, we should find that we are tied with cotton thread to almost every nation, people, and tribe upon this big round earth.

Is it not interesting to know that the little white, yellow,

brown, and black children of the world are largely dependent upon us for the clothes they are wearing; and that they and their parents are working to produce something to send back to us in exchange? As we continue our travels we shall see the many things they are making for us, and shall learn that the world is one great family, the members of which are always laboring for and trading with one another. That cotton, in the field over there, which those little American children are now aiding their parents in gathering, by this time next year may be in some blue or white gown worn by a yellow-skinned boy of China; and that boy, even now, may be gathering mulberry leaves to feed the worms which shall make the silk for the neckties and ribbons we may then be wearing.

The cotton in the next field may perhaps find its way southward to the Amazon River, and half clothe the nakedness of an Indian who is gathering the milk-white sap of the rubber tree to make our overshoes for the rainy days of next year. Or, perhaps, it may even go farther, into the hot wilds of darkest Africa, and form a waist cloth for a black savage who is now hunting elephants to supply us with ivory. Or, turning northward, it may find its way to the icelands of Alaska, as an exchange for the fur to make our muffs, collars, or caps.

The greater part of our cotton crop, however, will be used either in Europe or at home. There is no other plant that comes so close to civilized man, and none which we use so much every day of our lives. We go to sleep between cotton sheets, resting our heads on feathers inclosed in cotton pillow slips. We step out in the morning upon a cotton rug, pull cotton stockings over our feet, and

dress our bodies in garments made largely of cotton. If, in our hurry, we burst off a button, we sew it on with cotton thread; and then, having put on our shoes, tie them tight with cotton strings. We may wash our faces with soap made from the oil of the cotton seed, and dry them with a cotton towel. And so it goes on throughout the day. We have cotton before us in one shape or another almost every hour until, when tired out, we seek our rest; and then it is this cool white fiber that soothes our fatigue and gives us pleasant dreams.

"Suppose we pull up a cotton plant."

Suppose we pull up a cotton plant in this field where we now are, and ask it to tell us its story. If it could speak, it might boast that it belongs to the Gossypium (gos sip′i um) branch of the mallow family, and whisper in confidence that it is the first cousin of the hollyhock. It might tell us that it is fond of a hot moist climate, and show us a map of the regions where it grows best. From this we should see that cotton thrives almost all over the world between the thirty-fifth parallels on each side of the equator, and at its very best in the United States. It also thrives especially in India and Egypt, and grows well in northern Mexico and in some other parts of Africa, South America, Australia, and Asia.

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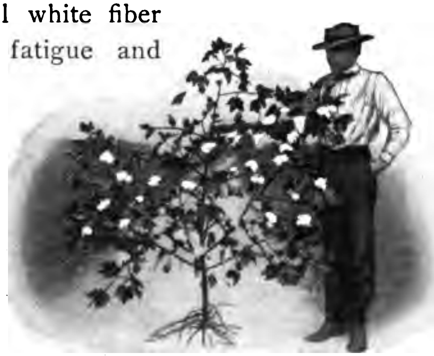

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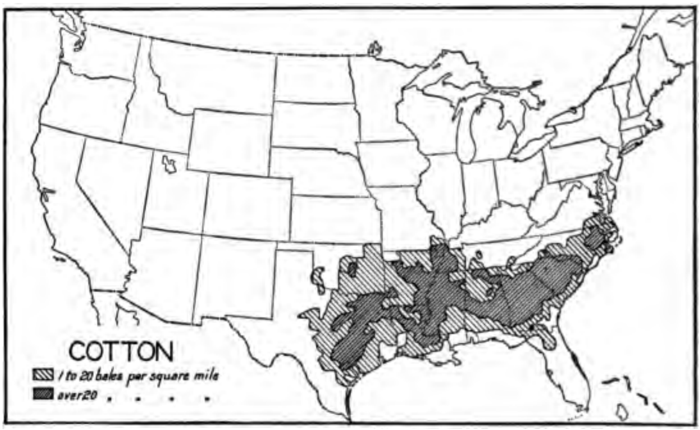
As to its history, the cotton plant probably originated in tropical Asia; although it was employed in Egypt farther back than the memory of man can go. The old Hindu priests used a cotton thread as an emblem of their holiness; and long before Europe began to weave cotton, the cloth was imported from India. In those early ages, while our forefathers were still clad in skins or wool, travelers from Europe, who had visited Asia,



Where cotton thrives in the United States.

spoke of it as a wonderful land, where the wool grew upon trees in fleeces which exceeded in beauty those of sheep. The Greek historian, Herodotus, who lived long before Christ, tells us about this; and in 1322 A.D. an English traveler, Sir John Mandeville, wrote a marvelous story about the cotton plant. He described it as a vegetable lamb, and said that it was a little beast which grew as the fruit of a plant. He said that this lamb had flesh, bones, and blood, and stated that he had seen and eaten

it himself. About this same time there were many other stories told concerning this wonderful vegetable lamb of Tartary. One was that it could bend down the tall stem on which it grew, so as to eat the grass round about, and that when the grass was all gone, it died. The wool on its back was said to be fine, and to be used by the natives as clothing. We all know now that these stories were not true, but we can easily see how they might have been believed by ignorant people who were shown the cotton cloth, but who had never seen the plants which produced it, nor any cloth of a similar character excepting that made from sheep's wool.

For a long time India was the chief seat of the cotton-growing industry. The plants were probably carried from there to Africa; for cotton was used in Egypt long before Christ was born, and an explorer who visited South Africa, shortly after Vasco da Gama made his voyage around the Cape of Good Hope, found that the natives there had cotton cloth. The ancient Romans appreciated the value of this material. The great Julius Cæsar used tents of cotton, and it is related that he stretched a cotton roof over the Forum at Rome. We also know that cotton was cultivated in Spain more than one thousand years ago.

As to our own continent, the cotton plant seems to have always grown here. When Columbus first landed on the Bahama Islands, the natives came out to his ships in canoes, bringing cotton thread and yarn to trade; and in Cuba he saw cotton hammocks in general use. A little later Hernando Cortez, who subdued the Aztecs in Mexico, found them weaving and wearing cotton; and another Spanish general, Pizarro, who conquered Peru

and got so much of the precious metals that he was able to shoe his horses with solid silver, discovered not only that the natives there knew all about cotton, but that their mummies, which had been buried ages before, were wrapped in such cloth.

As soon as our own country began to be settled, our forefathers experimented with cotton. In 1621 they planted some near Jamestown, Virginia; and they were so successful with it in Georgia that, at about the time George Washington was first elected President of the United States, a bale was sent from there to England. When the American cotton arrived in Liverpool, it created great excitement; and it was hard to make the customs officers believe that it was not imported from Asia.

Shortly after this it was found that the most of our Southern States were well adapted to cotton growing. Little plantations were set out here and there, and when the cotton gin was invented, raising cotton became profitable. One of the great troubles, however, was the lack of men to work the plantations, and it was this that induced the importation of negroes from Africa to be used as slaves.

As time went on our cotton crop steadily increased. In 1790 it amounted to five thousand bales, and in 1800 to more than two hundred thousand bales. Since then it has grown to such an extent that we now raise from eleven to thirteen million or more bales in a single year; and we are producing more than three fourths of all the cotton used by man. We are selling vast quantities of raw cotton to Europe, and some to South America and Asia; and we are also making cotton goods for export to

all parts of the world. The amount of money we receive from our cotton is so great that we can hardly comprehend it. In some years it is four or five times as great as all the silver and gold that are dug out of our mines in those years. If it were distributed in five-dollar gold pieces, every man, woman, and child in our country could have one, and there would still be millions left.

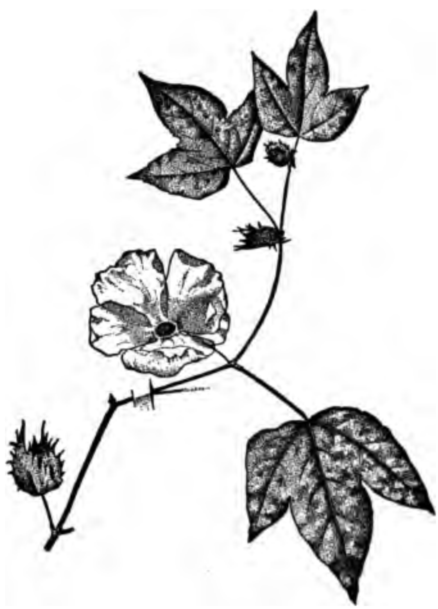
The regions where our cotton can be profitably grown have of late years increased in number and in size. Most of them are scattered over a vast territory south of a line reaching from beyond Dallas, Texas, to Wilmington, North Carolina, and including much of Texas and Oklahoma, as well as of Georgia, Florida, Alabama, Mississippi, Louisiana, Arkansas, Tennessee, and of North Carolina and South Carolina. Of all our States, Texas is now producing the most cotton, its annual product sometimes exceeding all that raised outside the United States by thousands of bales.

4. IN THE COTTON FIELDS. GINNING

TRAVELING on through the cotton belt, we visit plantation after plantation to learn how cotton is prepared for the market. We go out with the pickers and pull the lint from the bolls. We ride with the colored drivers on the huge wagons which carry the cotton to the ginning establishments, rolling each other over and over in the fleecy white wool, until we look as though we had passed through a snowstorm. We watch men baling the lint in great presses, and go on with the bales to the cars

and boats, and see them loaded for their long trip to the factories.

We spend much time with the farmers. They are hospitable and show us over their plantations, and from them we learn how cotton is grown. The work begins with the early spring. The plows are started as soon as the frost is out of the ground, and by March or a little later, the soil has been made soft, fine, mellow, and ready for planting. The fields are now laid off in rows four feet apart; and then men, women, and children go through and drop the black seeds; or they may be put in with drills drawn by horses or mules.


Cotton leaves and blossom.

The plants soon sprout and push their way through the soil, making long ribbons of green over the fields. The next process is chopping the cotton. This means cutting out about two thirds of the plants, so that they stand a foot or so apart in the rows. The cotton stalk is one of the hungriest of the vegetable kingdom; and it must have plenty of soil to make it grow

well. It prefers to stand alone and to be kept free from weeds; and so the crop is plowed and hoed several times, much like corn.

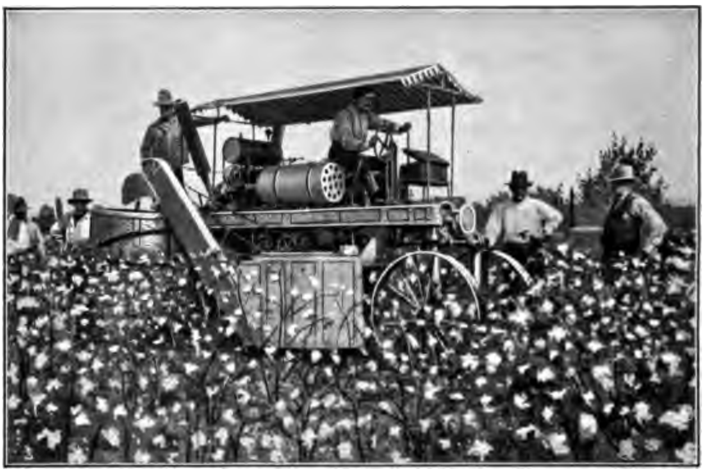
As the plants grow they send out branches, and in time become stocky little bushes about as high as a table. They have green leaves similar to those of the maple tree, and, along about midsummer or a little later, beautiful blossoms. At this time the fields look like great gardens of pink and white roses. The blossom is white the first day; on the next it turns pink; and three or four days later it drops off and a green boll appears. This is tiny at first, but it grows from day to day for six or eight weeks, apparently swelling with pride at the white lint inside it. It continues to swell until it is as large as a hen's egg, when its skin gradually bursts or cracks open, and the cotton is ready for picking.

"... its skin gradually bursts or cracks open."

If we examine it now, we shall see that each boll has from three to five little cells, containing many dark brown seeds tightly wrapped around and around with the white cotton fibers, or lint. If we pull the fibers apart, we

shall find that they are fastened to the seeds much as our hair is to our heads, and that they cover them so that nothing of the seeds can be seen. The cotton must all be picked, and the seeds taken out before the lint can be used.

The season for this work lasts many weeks. The cotton does not all ripen at once, and the pickers must go over each field several times. In the far South, along the Gulf



Picking cotton by machinery.

of Mexico and in Texas, the picking starts in July; towards the north it begins later, and in the Carolinas there is a little cotton still left on the stalks at Christmas.

The picking must be carefully done. It is sometimes performed by machinery, but usually by hand. It is paid for at about one half cent or more a pound, two or three hundred pounds of seed cotton being a good day's work for one man. The yield varies greatly according to the

season, and also to the soil and place where the cotton is raised. We have many large tracts which produce a bale, or five hundred pounds of lint, to the acre; but on the average, the crop is not one half this amount, and in some places, where both the land and the methods of farming are poor, it requires several acres to yield as much as one bale.

Some lands will produce far better cotton than others. The cotton is valuable according to the hairs, or fibers, of which it is composed; and these vary in length and character in different localities. In India, for instance, they will not measure over three fourths of an inch, while in Egypt they are twice as long or longer. Our cotton is on the whole better than that of any other country, and we have one variety which grows on the little islands off the coast of Georgia and South Carolina and in some places in Georgia, South Carolina, and Florida, which is the best cotton of the whole world. This is known as Sea Island cotton, and its fibers are so long, fine, and silky that, when marketed, it brings several times as much a pound as ordinary cotton. This cotton has blossoms of a rich cream color and small black seeds, which can be easily separated from the lint. The fibers are sometimes as long as one's little finger; and they will average one and three fourths inches in length. Sea Island cotton is especially valuable for making the finest sewing thread, for lace work, and for lawns and muslins.

Our Gulf cotton and much of that grown in Texas has also long fibers, but not nearly so long as those of the Sea Island; and the fibers of our Upland cotton, which forms the most of the world's crop, are neither so

long nor so strong as those of the Gulf or the Sea Island cotton.

We are surprised to learn that there is such a difference in cottons, and that the several kinds bring different prices. We have about as many varieties of cotton as of apples, and the cotton crop of the world is of many different grades according to its texture, length, and even its color. Each variety has its own character. The Sea Island cotton plant grows to a height of twelve or more feet. Gulf cotton is often not half so tall, and Upland cotton, and most of that of India and China, is but little higher than our waists. The Peruvian cotton grows up to ten feet, and India has cotton from a little tree twenty feet high, which produces a crop year after year. Upland cotton is white, the Sea Island lint has a creamy tint, the cotton of Peru is reddish, and some of the best raised in Egypt is brown.

Sea Island cotton plant.

We import some Peruvian cotton, whose fibers are rough and hairy, to mix with wool in making cloth and hats; and we annually buy large quantities of the Egyptian lint to make mercerized cotton, which looks like silk, and also to

mix with our cotton in manufacturing underwear and fine stockings. At the same time a part of our crop goes to other cotton-growing countries for similar purposes, so that much depends upon the fibers of which the lint is composed. We shall understand this better, perhaps, after we have gone through one of the factories where the lint is turned into cloth.

Let us now see how these little white fibers are torn from the seeds to make the raw cotton of commerce. This process, called ginning, is the basis of the whole cotton industry. A little more than a century ago, the only means of separating the fibers from the seeds was by hand, and it then took one person working hard a whole day to save a pound of white lint, and almost two years to gather one bale. It cost so much that it was not profitable to raise cotton, and little was grown. Now we have ginning machinery moved by steam, which will separate as many as fifteen bales or more in one day, a single gin thus doing the work of several thousand men; and there are smaller gins, turned by mules or horses, which can each do as much as five hundred or more men could in the past.

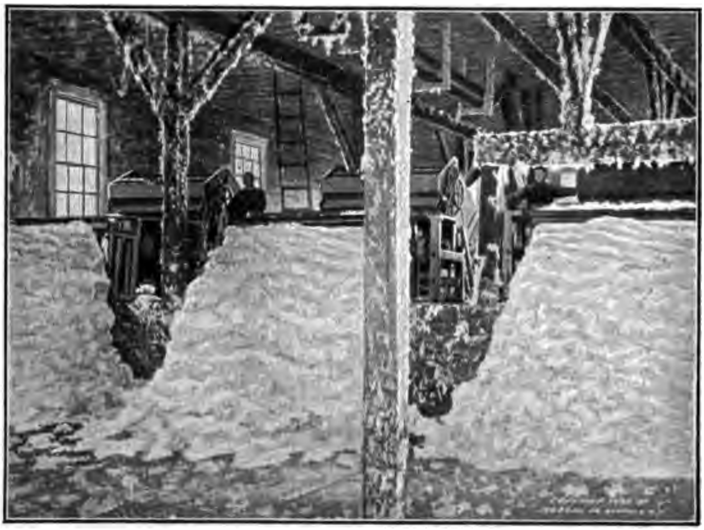
These machines are all based upon the invention of Eli Whitney, a young school-teacher, to whom the whole world is much indebted for the cotton clothes it is wearing. Eli Whitney was born in Massachusetts in 1765, eleven years before our Declaration of Independence was signed. He made some inventions as a boy, and among others a long pin for fastening on a woman's bonnet. Young Whitney was educated at Yale College and then went south to teach school. While in Georgia, visiting on the

plantation of General Nathanael Greene of Revolutionary fame, he invented some toys for the children and an embroidery frame for Mrs. Greene; and Mrs. Greene told the general that she believed Mr. Whitney could, if he would try, invent some way to separate the cotton lint from the seed. Eli Whitney modestly disclaimed being a genius of any sort, but he said he would make an attempt. He then took some seed cotton from the fields near by to a room in General Greene's house and began to experiment how to invent a machine for cleaning it. He had to make most of his tools and even draw his own wire; but he persevered, and the machine, when completed, was a success. It has been improved upon since then, but the essential parts are as he left them.

"He . . . began to experiment."

But here we are at a great modern ginning establishment. It is not far from the cotton fields, and there are

long lines of wagons just in from the plantations, waiting for their loads of cotton to be ginned and baled. The factory is operated by a steam engine equal to eighty horses all pulling at once; and it makes so much noise that we pick up some lint and stop our ears to keep out the din. It has four gins of seventy saws each, and is now



Ginning cotton.

cleaning ten or fifteen thousand pounds of cotton every day.

There is a wagon unloading now. The driver has stopped right under a flexible pipe which extends out from the mill and down into the cotton. See, the white lint is moving! It is being sucked up by machinery into the pipe, and carried through fans which clean it of dust. We go in and are shown how it drops into the gin, and how the

little saws tear off the fiber, which, as it falls, is brushed off in a great sheet of fleecy white wool. This is carried by machinery into the presses where by an enormous pressure it is squeezed into bales, which are wrapped in bagging, bound about with iron bands, and thus fitted for shipment. The cotton is not touched by man from the

Bales of cotton.

time it leaves the wagon until it is rolled out at the end ready for the steamers or cars.

At the same time the seeds are blown off into a distant room, where they are shoveled into box cars and sent to the factories which use them for making cotton seed oil and oil cake. The oil is employed largely in the manufacture of soaps and patent butters, such as oleomargarine. It is also used for lighting and for manufacturing phonograph cylinders. It is good for salads and cooking, and is

often sold as olive oil. The oil cake is made of the seed after it has been ground and the oil pressed out; it forms an excellent food for cattle. Formerly the seeds were thrown away or burned. Now they are so valuable that they are carefully saved and bring in many millions of dollars a year.

Have you ever seen a cotton bale? That of America is usually a hard bundle about four feet square and five feet in length. As it stands upon end, it is as high as our heads; and when we climb upon it and stamp it with our heels, we cannot make a dent in it, the cotton is pressed down so tight. An American bale usually weighs about five hundred pounds, that of Egypt seven hundred, and that of India less. Some bales are barrel-like in shape; but all are tightly pressed and bound, in order that the cotton may be more easily packed away in the cars and steamers. This is done in great cotton presses, which are found at every large cotton port.

Only about one half of our cotton crop is consumed at home. We annually export thousands of millions of pounds; and in some years other nations pay us more for raw cotton than for all our wheat and corn and other farm products put together. Our best customer is the United Kingdom, which weaves more cotton goods than any other land upon earth. Next comes Germany, and after that come France, Italy, Spain, and other countries of Europe. We send some raw cotton to Asia and especially to Japan and China, although they both raise cotton at home.

Among the foreign countries which produce cotton, the chief are India and Egypt. Small amounts also are raised

in the several colonies of eastern and western Africa; in Mexico, Peru, and Brazil to the south of us; and also in Persia, Asia Minor, and Russian Turkestan. In some of these regions the cotton plantations are growing in number and size, but just now there is little danger that they will affect the demand for our cotton in the world's markets. Mankind is using more and more clothing made from these fibers from year to year. The demand increases more rapidly than the growth of the cotton fields, and if the day ever comes when all the world shall wear cotton clothes, it will take several times as much as Mother Earth now produces to give even one suit for each of her children every twelve months.

Egyptian cotton pickers.

5. COTTON MANUFACTURING

WE have ridden from the fields on a train of cotton bales to one of the factories near by, where the white lint is woven into cloth. The negroes sing as they unload the cars, rolling the huge bundles about and moving them on trucks from one place to another.

The mill covers several acres. It is a huge building of four stories, with many windows to supply light and air. It is filled with machinery, and the noise in some of the rooms is so great that we shall not be able to hear ourselves talk. Nevertheless, the girls working here are said to

"The mill covers several acres."

understand what their fellows are saying by watching the movements of the lips.

The factory employs several thousand men, women, and children. They come to work at seven o'clock every morning and labor all day, year in and year out, in turning this white lint into cloth.

This huge factory is close to where the cotton is grown. It is one of the new mills of the South that, within recent years, have been so rapidly increasing in number and size. For a long time almost all the cotton woven in our country was made in New England; and even now there are

great mills in Massachusetts, Rhode Island, and other places which produce vast quantities of such goods. The mills in Fall River, less than two hours by train from Boston, weave two miles of cloth every minute of every working day, and enough in one year to form a wide cotton belt around the waist of old Mother Earth on the line of the equator.

Almost all the cotton mills of the South have been established within the past thirty or forty years. One thing that helped start them was the Cotton Exposition of Atlanta in 1881. At that Exposition the Governor of Georgia appeared one evening dressed in a suit of clothes manufactured on the ground from cotton which had been picked in the morning of that same day in sight of the visitors to the fair. This showed the people how easily and quickly cotton cloth could be made right in the cotton fields. Mills soon sprang up throughout Georgia and in the Carolinas and other States, and now many parts of the cotton belt are peppered with cotton factories. The southern Appalachian Mountain system has a vast number of streams that furnish water power for generating the electricity, by which many of the modern mills are run; and, as it also has plenty of coal for steam, the mills there can be operated at a low cost. Moreover, they have the advantage of being near where the cotton is grown, and therefore can save the expense of the long haul of the lint, which the distant weaving centers must pay.

Nevertheless, through the machinery of commerce the rates for carrying things, in large quantities on cars and ships, are now so low that the freight adds only a little to the cost of the goods; and this difference is sometimes

made up by other advantages that the far-away factories may have. Their water and climate may be better for weaving, they may have better or cheaper labor, and may be nearer the people who are to wear the goods or to those who can better export them to other lands.

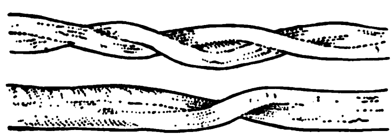
For these reasons a large part of our cotton crop is turned into cloth by people who live far away from the cotton belt. Indeed, the chief cotton-weaving center of the world is several thousand miles from the nearest cotton field, and that in a country which raises no cotton at all. I refer to the little county of Lancashire, in western England, where a great part of our cotton crop goes, and where more raw cotton is made into cloth than in any other place in the world. Lancashire County seems to have been fitted by nature for cotton spinning. It has just the right climate, a moist temperature, and a copious water supply. There are hills on the east of it forming a watershed and it lies in a basin covered with a bed of stiff clay that holds the water, allowing it to evaporate just fast enough to keep the air in the moist condition needed to fit the fibers for weaving.

Steamboat loaded with cotton, Mississippi River.

As we shall see later, these little white hairs of the cot-

ton wool are delicate, and they must have the proper conditions or they cannot be spun and woven into the best cloth. If the atmosphere is too warm or too dry, they become brittle, and will not twist well; and if it is too wet, they collapse and stick. In Lancashire County these things are just right, and largely so because of the stiff clay bed under the soil. In this we can see one of the geographical reasons why, in that far-away place, such a great industry has grown up, employing many millions of dollars and hundreds of thousands of people in making clothing for the world. In our own country very fine cotton goods are woven at New Bedford, Massachusetts, because the moisture in the atmosphere there is just about right for weaving.

Suppose we examine the cotton fibers more carefully. All animal and vegetable tissue is made up of fibers of one kind or another, woven together by nature. They are to be found in wood, flowers, and flesh, although some are so fine we cannot see them with the naked eye. If we put them under a strong microscope, however, we shall observe that they are all composed of very small fibers, and that these fibers are made up of fibers smaller still.



Cotton fibers, magnified.

Among all fibers, there are only a few so formed by nature that they can be twisted and spun into the strong thread needed for cloth. We can twist, braid, and weave together certain smooth vegetable fibers and also the hair of horses and of human beings, but the strands will be

loose and soon come apart. It is different with wool, silk, and cotton, and with the other textile fibers, and we can see why, when we look closely at each under a microscope. The woolen fibers are hollow tubes, waving and curly, so that they easily combine. On their outsides are many little scales, overlapping each other like the scales of a fish, which catch and, when woven, make the fibers cling tightly to one another. Each strand of woolen yarn is made up of thousands of these little fibers. The nature of the silk fibers is such that they can be easily woven; and this is true also of flax, from which comes our linen, and of hemp, jute, and China grass.

The cotton fibers are about the most delicate of all. They are so thin that a thousand of them placed one on the top of another would not reach the thickness of an inch; and it takes many millions of them to make one spool of thread. It is estimated that there are one hundred millions of these little hairs in one pound of cotton. There are fully as many in Johnny's shirt or Mary's calico dress. There must be several million fibers in a cotton handkerchief, and every one of us, I dare say, has now on him more than one hundred millions of these little hairs pulled from the seeds of the cotton plant.

Suppose we take a bit of cotton wool, and look at it under the microscope. Each now appears as a flattened spiral white tube or hollow ribbon, which, when cut in two, shows an irregular cavity within its rather thick walls. It is this spiral or twisting character, formed perhaps by being bound so tightly about the seed, that makes the little fibers combine together, and thus fits them for spinning and weaving. It is their hollow nature that

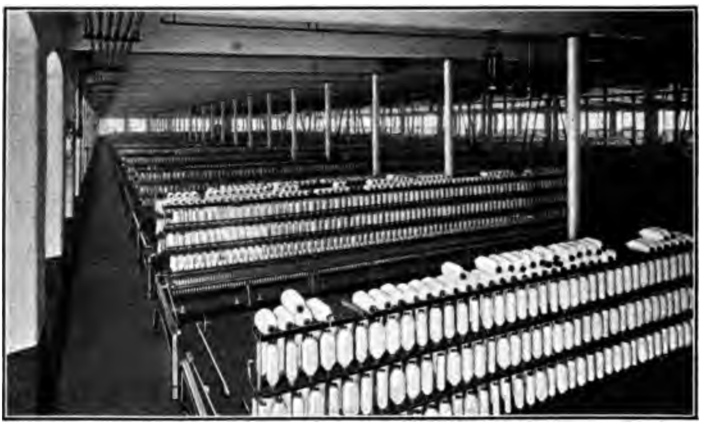
makes them take the dyes better, enabling us to have clothes of many colors and patterns. We can see now why the length, strength, and fineness of the fibers makes the cloth better or poorer; and why that of the Sea Island, which is so long, strong, glossy, and silky, is the best.

It took men a great while to learn how to combine these little hairs into cloth. The first spinning and weaving was by hand; and it is so done to-day, in a small way, among many semicivilized peoples. At Omdurman, in Africa, where the two chief branches of the great river Nile come together, I have seen the black women of the Sudan ginning cotton between rollers no bigger around than a broom handle. The women sat on the ground and caught the seeds with their hands while the lint passed in through the rolls. They carded the cotton with rude wire combs, and then, placing a bunch of it on a forked stick called a distaff, spun it into thread by twisting the fibers together with the thumb and finger and winding the thread on a spindle. At the same time, in a mud hut near by, the thread was woven into cloth by half-naked Sudanese boys, who worked upon rude hand looms. It was in this way that our ancestors of long ago made their first cotton cloth, and this was followed by the old-fashioned spinning wheels upon which our great-grandmothers spun their thread.

Some such methods were employed in India long before men learned how to weave cotton in Europe. In this rude way the East Indians made cloth, so thin that a piece big enough for a whole dress could be pulled through a finger ring, and so fine that it went by the name of "woven wind."

In olden times cotton spinning and weaving required so much labor that the goods were costly, and comparatively

few were made. This condition continued until 1767 when James Hargreaves, a poor workman at Nottingham, England, invented the spinning jenny, which spun from sixteen to thirty threads at a time, the operator working the machine with one hand and controlling the thread with the other. This was afterwards improved upon so that from



Spinning mules, New Bedford, Mass.

eighty to one hundred threads could be made at the same time by one little girl.

Soon after this Richard Arkwright, a barber and hair dyer of Nottingham, invented a machine for spinning by means of rollers, and a carding machine to straighten the cotton fibers so that they could be more easily spun. And it was at just about the same time that Richard Crompton combined the principles of these two inventions and made the spinning mule, or mule jenny, which is substantially the machine in general use at the present time. The first spinning mules had only twenty or thirty spindles each;

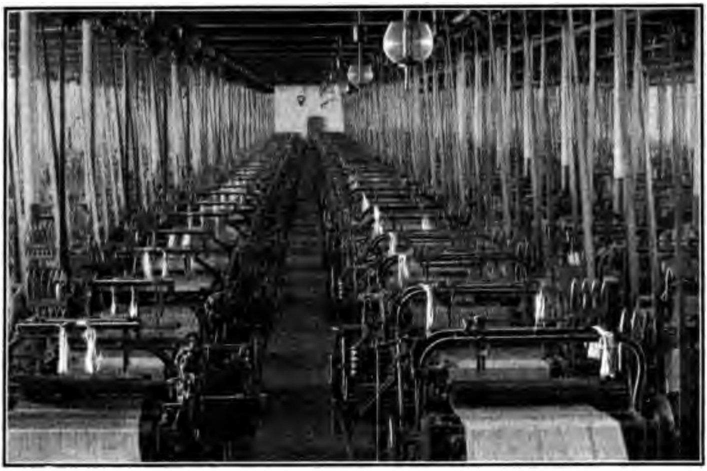
but those we now use have a thousand or so, all operated by one person.

These inventions made it possible to make thread rapidly and cheaply, and it needed only the discovery of how to weave by machinery to enable man to produce great quantities of cloth at low cost.

The only method of weaving so far discovered, however, was by hand looms, and that was slow and expensive. Let us take up a piece of cloth and observe the threads in it. There are two sets of them which cross each other at right angles, being laced in and out, so that they form one continuous, closely connected whole. As we tear the cloth apart and unravel the threads, we can see how they cross, each running over and under the others, throughout the length and breadth of the piece.

The art of putting the threads together so that they make a continuous whole is called weaving. It is done both by hand and by machinery, and in both cases in much the same way. There is one set of threads called the warp, which goes lengthwise of the cloth, and another set called the woof which cross these, going regularly in and out, over and under, the threads of the warp. Simple weaving consists in fastening the first, or warp, lengthwise threads to a framework in such a way that half of them, consisting of alternate threads, can be raised and lowered at once, in order that the cross, or woof, threads may be easily thrust back and forth and go over and under the threads of the warp. In the old hand looms the workman raises or lowers the warp threads by pressing his feet down on the treadles of the loom; and he then puts in the cross threads by means of a little bobbin or spool called a

shuttle, which he throws from one side of the cloth to the other. He then pulls down the loom and closes the threads tight before the frame is again raised and the shuttle thrown back, making a new thread of woof through the warp. With the hand loom this process is slow; but it



Power looms, Manchester, N.H.

goes on all day long, and, thread by thread, and yard by yard, considerable cloth is woven.

Shortly after these inventions for spinning thread were made, an English clergyman, Dr. Edmund Cartwright, began to study whether some mechanical way might not be found to do the work of the weaver; and it was during a visit to Arkwright's cotton mill that the idea of the power loom occurred to him. His invention revolutionized the cotton industry. It has been greatly improved upon since then, and we now have mills which contain hundreds of power looms, run by steam and electricity,

which weave cloth so rapidly that one mill will turn out thousands of yards in a day, and so cheaply that a yard of cotton cloth costs but a very few cents.

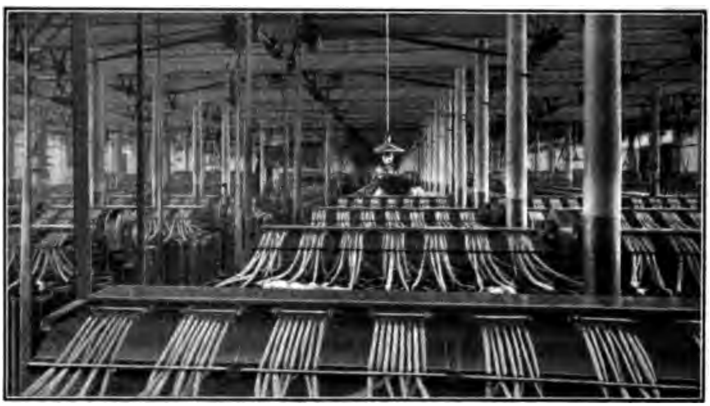
6. A VISIT TO A COTTON MILL

WE shall now go through the factory and see with our own eyes many of the things we have been talking about. We shall start with one of the cotton bales, upon which we rode in from the fields, and follow the processes by which it is turned into cloth. The bale is first opened, and the fleecy wool, we saw so tightly pressed at the gin, is torn loose by machines which pull it apart. It is beaten up by other machines, and the dust, leaves, sticks, and dirt are blown out. The wool is then run over great cylinders or rollers called openers, and so treated that when it leaves them, there is not a stick, a leaf, or a grain of sand in it.

Let us now pick up a handful of the lint and feel it. It is as soft as swansdown, and whiter than when picked in the field. If we look closely at the fibers, we shall see that they are all mixed together. They are turned this way and that, and they cross and recross one another. They must all be laid the same way before they can be spun into thread. This is done by the carding machines, in which the wool passes between many huge rollers covered with little wire teeth, which brush and comb the fibers, as they go through, much as we comb our hair. The teeth are so fine that there are a hundred or so on a space as big

as a cent. They pull the tangled hairs apart, and comb them again and again until they lie as straight as our own hair when well brushed. The machines now roll these little spiral cotton fibers over and over, so that they cling to one another, and come out in a thick rope of soft cotton yarn. They are now in the proper shape to be twisted for thread.

But let us look at this soft rope a little further. It is as large as a broom handle, and it seems thick enough to



Making cotton threads, New Bedford, Mass.

make a dozen fine threads. It is not large enough to make one. It must be twisted and doubled, and twisted and doubled again and again, before it will be fitted for weaving. This is done by passing the soft rope through one machine after another, each of which twists it a little tighter until it is no thicker than a fishing line. Now strands of a similar thickness are added to it, and all are retwisted until they come out as fine cotton yarn. They are then

put on the spinning frame and spinning mule, and, in the end, are brought out as the fine thread used for weaving.

When the thread is made, it is wound upon spools or spindles. That intended for the warp, or long threads, is then wound about rollers of the width of the cloth to be made; while that for the short, or woof threads, is wound upon little bobbins, which can be put into the shuttles and thrown, at a speed of one hundred and fifty or more times per minute, through the long or warp threads, from one side to the other.

We observe that there are more women than men working in our factory. There are also many children, who tend the spinning mules and aid otherwise in the weaving. The vast rooms are alive with machines. Long lines of white threads are flying to and fro among the black bands and iron wheels; and great sheets of cotton goods are rolling forth, ready to be folded and baled up for shipment to all parts of the world.

If we should now cross the Atlantic Ocean to England, we might find at Manchester, in Lancashire, many factories even larger than this. I once visited a cotton mill there, whose buildings covered twelve acres; they contained three thousand power looms and one hundred and twenty thousand spindles. The mill employed three thousand hands, and it wove three hundred miles of cloth, one yard wide, every week.

Some of our raw cotton used by this mill came by sea to Liverpool, and thence on by rail; and some, after crossing the Atlantic, came up the Mersey River and the Manchester Ship Canal to Manchester. At Liverpool I saw the cotton exchange, where hundreds of buyers come

together every Thursday and Friday to bid for the cotton sent there from the United States and from South America, Egypt, India, and other parts of the world. The cotton is sold by sample, and many little messenger boys carry bundles of cotton wool, done up in brown paper, from one broker to another. The cotton which came by the Manchester Ship Canal was loaded at Galveston, New

Cotton Exchange, Liverpool.

Orleans, or some other southern port; and it was not taken out of the steamer until it was landed at the doors of the factory.

Large quantities of cottons are woven in Continental Europe. The Germans and the French annually buy millions of dollars' worth of our raw cotton and make it into cloth. The Italians consume a great deal of it, and so do the Belgians, Swiss, and Dutch, each nation export-

ing the goods made from it to other countries. In normal times the Russians, besides cultivating cotton fields in western Asia, buy millions of dollars' worth of raw cotton from the United States; they weave goods, not only for their own people, but also to sell to the Persians and other Asiatics.

India has vast cotton mills, many of which are situated near Bombay. That country ranks next to the United States in the amount of its cotton crop; although it often produces less than one ninth as much as we do. The East Indians, as we have already learned, are amongst the oldest of the cotton-weaving nations, and their mills still consume the greater part of all the cotton they raise.

No one knows just how much cotton is grown by the Chinese, but there are many cotton fields in the Yangtze Valley ranging from one fourth of an acre to five acres in size. The seed is sown broadcast, and the plants are afterwards thinned out. They are carefully weeded, and are hoed with long slender hoes. In China most of the cotton picking is done by women and girls, who in some places receive only a few cents a day. After the crop has been gathered, there is a time fixed in each district when the poor have the right to go out and pick all the cotton that may have been left. At such times they will walk for miles, to reach a place where the picking is good; and they sometimes sleep over night in the fields that they may start work when the day breaks. Of late our methods of raising cotton have been introduced into China.

There are many million people in China; and as nearly all wear cotton clothing, they must have a great deal to go round. Most of the cotton raised in China is ginned,

spun, and woven at home. Until lately, the cloth used there was made almost altogether by the Chinese women in their little huts upon hand looms; but now huge factories are building at the ports and in the cotton-raising centers, and a vast deal of cloth is being woven just as we weave it at home. I recently visited a cotton mill at Shanghai which employed several thousand hands. Most of them were almond-eyed Chinese girls, who rode to their work on wheelbarrows.

Hand loom, China.

Chinese factory girls riding to work.

As I went through the factory, I found that parts of it contained the best of modern weaving machinery, and was told that the Chinese girls were doing excellent work. I saw some of them moving about their machines and arranging the threads as skillfully as white girls. Others sat upon benches, and turned reels by moving their

feet up and down on the treadles. Their labor must have been very tiresome, and their pay was small, but I was told that they do not complain as they are anxious to make money by doing this work.

Crossing from China to Korea and Japan, we find that cotton is raised in both of those countries, and that in Japan there are large cotton mills. The Japanese import many million dollars' worth of our crop; and they make such beautiful goods that we are glad to buy them ourselves; although in the cost must be reckoned the expense of sending our cotton across the Pacific Ocean to Japan, as well as that of bringing the manufactured goods all the way back to us.

Ought we not to be much interested in knowing about these ingenious people with whom we are always trading? Many of the things we make go to the Japanese, and many that they make come to us. The money received from Japan for our raw cotton goes back to the American families who raised it, and the Americans who buy the beautiful Japanese goods are really paying the wages of the almond-eyed boys and girls who work in these far-away factories. In the same way we are closely related to many other nations and countries; and if we are sensible, we shall study our geographies and learn all about them and the parts of the earth in which their homes are.

7. FLAX

FLAX ranks next to cotton among the vegetable fibers of commerce. It is the material from which comes linen, and, like cotton, we have it with us all day long.

We dry ourselves upon linen towels after our morning bath. We sit down to our meals before linen tablecloths, and we often wear linen dresses, shirt waists, and collars and cuffs. We use handkerchiefs of linen, and if we are fortunate enough to have beautiful lace, it is probably composed of flax fibers. The strong thread used by the shoemakers is made of linen; and when we go fishing we

Gathering flax. From an ancient Egyptian tomb.

choose linen lines and seines, for we know they are strong enough to hold what we catch.

The cotton fiber, as we have seen, is part of the fruit of the cotton plant. The linen fiber comes from the stem of the flax plant. It is the soft silky lining of the bark which lies between the rough woody outside and the pith of the stem. It is many times as long as the longest cotton fiber, and thicker and stronger. Linen fibers are supple, glossy, and silky; and they have a rough surface which keeps them from slipping when twisted, and thus fits them for weaving.

The best flax has fibers almost as long as your arm; and it was probably on this account that man began to weave them many years before he discovered how to twist to-

gether the fine cotton fibers, which are generally shorter than one's little finger. At any rate, linen was used long before cotton was known. The cloths in which the ancient Egyptian mummies were wrapped are composed of flax fibers; and napkins laid away with them thousands of years ago have been washed and dried without injury. In the old tombs, under the sands of the desert, not far from the Nile, are paintings which were made ages ago when the tombs were built, showing the men, women, and children of those ancient times gathering flax in the fields and tying it into bundles, preparatory to taking out the fibers.

Flax is mentioned many times in the Bible. We know that the ancient Athenians wore linen gowns which fell to their feet, and that the Romans had fine linens. Charlemagne wore a shirt and drawers of linen, under a tunic embroidered with silk; and the garments of our Anglo-Saxon ancestors were of linen and wool. The Moors of Spain were famous for wearing fine cloth of this kind; and away back in the Middle Ages the people of the Netherlands and, after them, the Scotch, English, and Irish established a linen-making industry. To-day linen is woven in many places, but more than anywhere else in northern Ireland and Scotland, and in Belgium, France, Germany, and Russia, and also in Italy and Spain. Our own country weaves but few fine linens, our manufactures of flax being practically confined to sewing thread, twine, and towelings.

We have seen that North America raises so much cotton that it might be called the cotton continent. For a similar reason we might call Europe the linen continent; for

nearly all the flax grown for cloth is produced there. Moreover, the great bulk of our American cotton is raised in one locality, the Southern States; and in the same way, the great bulk of the European flax comes from one locality, namely, Russia. As our South grows more than three fourths of the cotton, so Russia grows more than four fifths of the flax woven into cloth by man. Other important flax-raising regions are Belgium, Holland, France, Germany, northern Ireland, and Egypt.

Russian flax growers.

In the United States some flax is grown; but the most of our crop is raised for the seed rather than the fiber; so we plant and harvest it by machinery, cutting the straw with reapers and thrashing out the seeds. The seeds are known as linseed; they are valuable for the oil and oil cake they produce. Linseed oil is used for making paints, varnishes, and linoleum and oil cloth. Linseed meal is manufactured from what is left of the seeds after the oil is pressed out; it is highly prized as food for cattle, horses, and other animals.

Suppose we cross the Atlantic Ocean and see something of the places from where our linen clothes come. We shall first look at the flax in the fields, and examine the plants. Here we are in the great black plain of Russia, not far south of Moscow. The country is flat, and we can see for miles in every direction. There are no fences and no solitary houses or barns scattered over the landscape. The people live in villages of log cabins, and go out from them in gangs to work the crops, all laboring together and coming home together at night. A great deal of the land of Russia belongs to the villages as such, and not to the individuals in them, as with us. It is for this reason that the lands are worked in common, the harvest being afterwards divided among the families composing a village. This is so in the region where we now are. We see scores of women and girls in the fields. They are down on their knees among the green flax, pulling the weeds; they sing as they work, looking up now and then at that man who acts as their overseer, and makes each do her duty.

Have you ever gone through a flax field in blossom? That beautiful sight greets us wherever we look. Here and there, scattered over the country, are vast beds of tiny blue flowers which are rising and falling under the wind. In the nearer fields, under the blossoms, we can see the flax stems. They are straight and are about as high as our waists. Now let us take a good handful up by the roots and try our strength to see whether two of us can break the straws by pulling upon them. It is almost impossible, the stems are so strong.

The flax has been bruised in handling, and we carefully tear it apart and look at the fibers. They are on the inner

side of the bark next the pith, running through the stem from the blossom to the roots. They are strong, fine, and silky; this we might see better later on, when the crop is ready for pulling.

Where flax is grown for its fibers, it is harvested before it is ripe, as if left too long the fibers will become stiff and

A field of flax in blossom.

coarse. They are at their best when only the lower portion of the straw has become yellow. Then the people come out and pull the stems from the ground. They shake off the dirt and tie them up in bundles, laying all the straws straight and the same way. The stalks are now drawn through iron teeth to remove the seeds at the top, and are then ready to be treated so that the fine

silky fibers within them may be taken out without breaking or otherwise injuring them.

This work is by no means easy. The fibers are delicate, and the woody bark and stem must be rotted off. The straw may be laid out on the grass and left to rot by the dew falling upon it; or it may be put into a pool or placed in running water. In Belgium it is sometimes loaded upon rafts, which are then sunk in the streams and again raised

Retting flax, Russia.

From Bulletin 71 of North Dakota Experiment Station.

by means of windlasses when the straw has reached the right condition for cleaning. These processes are called retting or rotting. In this process the woody parts of the stem ferment, and make a horrid smell. During the treatment the flax is carefully watched; for if it is left in the water too long, there is danger of rotting the fibers.

The next process is to break off the wood. The straw is first dried. The outer bark, wood, and hard parts of the plant then become brittle, the fibers remaining elastic and tough. It is now pounded with mallets or run through a machine that breaks to pieces all but the fiber, and it is next passed on into machines which scutch or scrape the fibers to get the broken wood out. This is sometimes done by hand, but generally in mills by paddles fastened to wheels. There are twelve paddles on each wheel, and they go about so fast that they strike the fibers at the rate of eighteen hundred times per minute. They cause a great dust, and the best mills have ventilation stacks by which blasts of air pass through the fibers during the scutching, carrying away all dirt and leaving them clean.

Scutching flax, Belgium.
From Bulletin 71 of North Dakota Experiment Station.

The fibers are now of a silver-gray color; and if we should put them under the microscope, we should see

that each is a long, straight, transparent tube with thick walls, the hole in the center being exceedingly minute. When greatly magnified they look rough, but to the naked eye they seem smooth and silky. They are now tied up into bales of two hundred pounds each, and shipped to the mills for spinning and weaving.

After the flax, so treated, arrives at the mills, it is hackled or combed to get out the long fibers which make the best thread, the short fibers, or tow, being saved for use in inferior cloth. The fibers are now sorted into different grades. They are run through combing or carding machines, and come out in long, thick, soft ropes called slivers, somewhat like the cotton rope we saw made into thread. These slivers fall into round tin cans which coil them; and a little bell rings at each revolution of the rollers, through which they go to tell the attendant when the can is full. Several slivers are then united by other machines to form a thicker sliver, and a number of the thicker ones are twisted and retwisted until they come out as thread.

The spinning is done much the same as cotton, save that the linen fibers are sometimes run through a trough of hot water, which so softens them that they spin better. In this process the spindles whirl about in the water, throwing a mist over the workmen, who wear waterproof aprons to keep dry. After spinning, the fine thread is boiled and washed. It is rinsed again and again, and then, if it is intended for white goods, is spread out on the grass in the sun to bleach. It is also woven unbleached and bleached in the cloth; or the thread may be dyed after certain processes, which we shall see later on.

Linen is woven in much the same way as cotton. In

olden times the flax was all spun by hand upon spinning wheels and made into cloth on hand looms; and this was continued until the spinning jenny or the spinning mule and the power loom were invented. These were adapted to weaving linen as well as cotton, and now there are vast factories in Ireland, Great Britain, Germany, France, Austria, and the Netherlands which make vast quantities of linens. In Belfast there is a linen mill that covers eight acres and employs twenty-five thousand men, women, and children in making tablecloths, napkins, and white goods for dresses. There are mills in Scotland and England that weave common linens only, such as towelings and sheetings, and in northern France some which make the finest of cambrics and linen lawns. Belgium is also noted for such linen goods, and likewise for its silky, silvery damasks, its handkerchiefs, and its lace, the strands of which are sometimes as fine as those of the spider's web. Most of these countries import much of their flax from Russia, but Russia weaves a great deal of linen for her own people, and so do Germany, Scandinavia, Italy, Spain, and other countries of Europe. As for the United States, it imports almost all the linen its people wear, and its only flax manufactures worthy of mention are sewing thread, of which we use a considerable quantity, and coarse toweling, of which we produce a few million square yards every year.

8. HEMP

IF we, like Bellerophon (bel-ler′o-fon), who fought the terrible Chimæra, had each a winged horse like Pegasus, which would take us across a continent or an ocean at

a flight, we might visit many strange places where vegetable fibers, other than cotton and linen, are used to make thread, cord, and clothing. If we should fly across the Pacific, and pull up our winged steeds at the Philippine Islands, we should there find a plantlike tree, similar to the banana, whose fibers form the world's chief material for all sorts of rope, from clothes lines to cables.

From it comes most of our twine, and also our jumping-ropes and hammocks and nets. Its fibers are woven into hats, canvas, curtains, and carpets; and the finer ones are mixed with silk in the manufacture of crêpes, veils, and women's hats of great beauty. Our little brown cousins weave them with the fibers of the wild pineapple plant into an exquisite stuff known as "Jusi (hōō-si) cloth." This plant is the *Musa textilis*, which grows better in our islands of the western Pacific than anywhere else in the world. The Filipinos term it the abaca; but we call it the hemp plant, the fibers being known as Manila hemp because vast quantities of them are shipped from Manila.

The abaca is raised throughout the Philippines, and we shall find it growing almost everywhere in Albay, in southeastern Luzon, where we land. Now we have left our winged horses, and are making our way through one of the plantations. We are in a great grove of hemp trees, the wide leaves of which sprout from the ground and almost meet overhead, shutting out the glare of the tropical sun, and making it cool in the heat of the day. The trees about us look just like bananas. They are plants rather than trees, although they grow to the height of a two-story house. Each is composed of many long, wide, green

leaves wrapped about a central stalk, which, when the plant is full grown, towers high above us. The fibers come from the inner leaves, there being so many that some plants at the base are almost as thick as our waists.

Over there are three little brown men cutting the stalks, and getting the hemp out. Each has a long knife not unlike a corn cutter, save that it has a heavier blade and is as sharp as a razor. See, one is chopping off a stalk now! His knife goes through the thick stem as though it were celery, and the plant falls to the ground. He next cuts off the top and strips away the green outside leaves, so that only a white pole five or six inches thick, and from six to ten feet in length, remains. We see that the pole has a soft central core running through the full length of the stalk. The core has many white leaves wrapped around it, and these contain the fibers we know as hemp.

Stripping hemp, Philippines.

We pick up one of the inner leaves as the man strips it off. Its outside is covered with fibers, and the inside is a pulp with fibers running through it from one end to the other. The pulp must be squeezed out before the hemp will be ready for use. The men are doing that now.

They are placing the soft, tender, white leaves, from which the skins have been stripped, one by one under a knife, which rests on a log, in such a way that as the man pulls them through, the juice and pulp are squeezed out, and only the fibers are left. The knife is held to the fibers by a treadle, upon which the man puts his foot, pressing the knife hard down upon them. When the fibers come out, they look like a skein of fine silk, and have only to be dried in the sun to be ready for the market. They run throughout the leaf, and many of them are ten feet in length.

Drying hemp fibers, Philippines.

Later on we watch the men drying the fibers, and at the ports see them pressing, sorting, and baling them for export. They wrap the bales in mats of palm leaves, and tie them with strips of rattan so that the cost is but little.

We talk with the planters. They tell us that the abaca is grown from the suckers about the base of the plant, and that, when a tree is cut down, many sprouts spring up around the stump. These sprouts are transplanted; they soon take root, and within about three years become trees ready for cutting. They do not need much cultiva-

tion, and it is only necessary to keep down the weeds. Our Filipino friends tell us the crop is profitable, and that it annually brings in many millions of dollars.

There is another plant grown in the Philippines which, although it has only a small part in the weaving industry of the world, produces some most beautiful cloth. This is

Agave plants.

the wild pineapple, whose thorny leaves contain long silky fibers which may be spun into threads so fine that embroidered gowns made of them have brought a thousand dollars apiece. The cloth is called Piña. It is usually woven on hand looms. The fibers are first scraped out and dried, and then combed and sorted.

In Yucatan there are plants somewhat similar to the pineapple known as the Agave, that furnish a fiber which

is surpassed in strength by Manila hemp only. The Agave is a relative of the century plant, and, like other plants of that species, it dies down when it blossoms, although the roots continue to live and send up new shoots. It has long thick leaves filled with fibers, which are taken out by machines made for the purpose. After being dried and put up into hanks, the fibers are shipped to the factories to make fine rope and bagging. They are known as Sisal hemp, and form quite an important product of Mexico, Central America, and the West Indies. The Agave can be grown also in Florida and the Bahamas.

But our winged steeds are waiting to carry us onward. We mount and direct them to take us northward to Japan, and thence westward through China, Russia, Italy, Austria, and France, and on, across the Atlantic Ocean, to our own State of Kentucky. In our flight we have passed over the chief hemp fields of the world. This hemp, however, is different from that we saw in the Philippines. It belongs to the nettle family, and grows in thin stalks that reach a height of from five to fifteen feet, ending at the top in a few small branches on which are dark green leaves. The stems are hollow, and the inner bark is made of fibers which extend the full length of the plant. The fibers are long, soft, and strong, and almost as good as flax for spinning and weaving. They are used for making fine twine, carpet thread, sailcloth, homespun, and other such goods. We consume many million pounds of them every year, importing far more than we raise ourselves.

Most of our hemp grows in the blue grass region of Kentucky, not far from Lexington, which is its prin-

cipal market. In raising it, the ground is prepared much as for other grains, and the seeds are sown, in the spring, at about one bushel to the acre. The plants soon sprout, grow rapidly, and, along in the late summer, are ready for harvest. They are then retted, and treated much like flax, to get out the fiber. After this they are packed into

Harvesting hemp, Kentucky.

bales of one hundred and fifty pounds each and sent to the market. The preparing the fiber for cord, rope, and cloth is much the same as that we saw in the making of coarse linens, the refuse being sold as oakum for calking ships.

The hemp seed is carefully saved. It is commonly used as food for caged birds. Birds like it so much that newly sown ground must be guarded until the seeds sprout, and the fields are carefully watched as the harvest approaches.

9. MINOR VEGETABLE FIBERS

THIS morning we are again on the wing. The world has so many plants, more or less valuable for their fibers, and they are scattered so widely over it, that we must make long journeys to see the most important of them. If we go to China, we can learn much about

"If we go to China, we can learn much about ramie."

ramie. This plant has fibers stronger than hemp, and almost equal to silk in their luster. It is from them that are woven grass linens and grass cloths, fabrics which resemble both silk and linen and make beautiful dresses.

Ramie is a nettlelike plant that sometimes reaches a height of eight feet. It bears large oval leaves which are green above and silvery beneath, and it has a thick stalk

with a pith in the center. The fiber lies on the inside of the bark. It is taken out by splitting the plant stems, which are retted, and then treated about the same as flax. The plants are grown from seeds and cuttings, and if the climate is right, they will produce three crops in one year. Ramie is raised in India, Africa, and South America, and it might thrive well in our States about the Mexican Gulf.

Jute.

Crossing now from China to Hindustan, we find in that country certain long vegetable fibers that are used to a greater extent than almost any others, except flax or cotton. These are from the jute plant. They are employed in making carpets, rugs, and various trimmings; and also in weaving gunny bags for packing cotton, rice, and other things. Some of the finer qualities of jute are used for shirtings and coat linings, and they are mixed with wool, cotton, and flax in cheap clothing materials.

The jute plant grows to a height of twelve feet with but few branches or leaves until near the top. In India it is cut about three months after sowing, when the blossoms appear. It is chopped off close to the ground, stripped of its leaves and branches, and tied up in bundles. The outer bark and the pith are rotted to loosen the fibers; and the stalks are then dried, cleaned, and beaten until

only the fiber remains. This is pressed into bales of about three hundred pounds, and shipped to the markets.

When the fibers arrive at the mills, they are ten or fifteen feet long, and must be cut into three-foot lengths before they can be prepared for spinning and weaving. They are spun by processes much similar to those used for flax, but the fiber is so rough that it has to be softened with whale oil and water before it is spun. In our country the weaving is done by machinery. Here in India it was for a long time made on hand looms, and we still find districts where the people are now working away, weaving these strong fibers into rough cloth.

A large part of the jute crop is exported to England and other parts of Europe, and there manufactured. Another considerable portion comes to our country, and we make it into jute rope and burlap. We use the fibers also for bagging, and for weaving rough carpets and rugs.

The best of the jute fibers are fine, and they have a satiny luster so that they are sometimes mixed with silk in cheap satins. They are also used for making canvas.

Much of the jute goods manufactured in India is for the United States; and until 1870 the bagging in which our whole cotton crop was baled came from here. So you see that our southern planters, although they live on the opposite side of the globe, were the chief supporters of these Hindu weavers and kept them at work.

In addition to jute, cotton, and linen, India has other vegetable fibers, which, although they have no part in the commerce of the world, are used by the natives. In Assam there is a nettle called the Ban which has fine

strong fibers of which the people make fishing lines and nets, and in Hindustan is another nettle, with a stem six or seven feet long, whose fibers are woven into a cloth, somewhat like silk. This silk nettle grows wild in the forests. The natives cut it and dry it in the sun; and then they boil it for twenty-four hours in ashes to separate the fibers from the woody materials of the stalk. The fibers are then cleaned and are spun into yarn, when they are fitted for making thread, cords, and cloth. One of the great disadvantages in using the ban is that its leaves are covered with hairs which sting the hands of those who gather it.

Our next flight takes us across the Indian Ocean to the highlands of Central Africa, and we alight in Uganda, on the edge of Lake Victoria, where its waters flow out to form the Nile River. We are now in a region where the dark brown natives dress in the fibrous bark of a tree, which makes excellent cloth without spinning or weaving.

This is a species of fig tree, which they raise in their gardens. It grows from twenty to thirty feet high, has a leaf somewhat like the ash, and branches which begin at ten or twelve feet from the ground. From time to time the bark is stripped from the trunk, great care being taken to leave a thin skin next the wood and to protect this by wrapping it with banana leaves until the new bark grows. When the bark is to be used for clothing, two rings, parallel to each other and some distance apart, are cut around the trunk, and a cut is made perpendicularly from one to the other. The bark can thus be taken away in great strips, each the full circumference of the tree.

After the bark has been stripped off, its rough outer

surface is scraped or broken away, and only the fine, soft inner fibrous part remains. This is soaked in water and pounded again and again with a hard wooden mallet, so crossed and recrossed with grooves that it seems covered with teeth. After the wet sheet has been well hammered, it is folded and hammered again. It is now folded a second time and again beaten, until it spreads to the width of a yard, and is of an even thickness throughout. It is now dried, and without further treatment is fitted to be sewed together for clothing. I have seen many thousand people dressed in such cloth, and have found it in use, not only among the negroes of Africa, but in certain tribes of Indians who live in the wilds of South America near the head waters of the Amazon River.

"The cloth looks as though it had been woven on a loom."

The natives of Uganda sew the bark into sheets or blankets the size of a bedquilt, and one such sheet forms a gown for a man or woman. The cloth looks as though it had been woven upon a loom. It ranges in thickness from that of fine canvas to a rather coarse blanket; it is soft, pliable, and warm. It is usually of a reddish brown color, but is sometimes bleached white or stamped with

black patterns. In wearing bark cloth, the woman wraps the big sheet about her body under the arms, leaving her neck and shoulders bare, and fastens it at the front with a knot or twist. The cloth now falls to her feet, and she ties it in at the waist with a belt of the same material. Such dresses cling tightly to the body, so that the natives can do all sorts of work in them.

Woman dressed in bark cloth.

These people like our American cotton better than this cloth, and many of them have taken to using it. The poorer classes, however, still have clothing of bark; and the boys are often dressed in these gowns, grown in their own gardens and made by their parents right at home. As for the little brown girls, up until eight or nine years of age, they have no clothes at all, excepting a ring of banana or other fiber, about as thick as this book, which they wear around the waist. A little Uganda girl does not consider herself dressed unless she has on this ring; and if she has left it off and sees a stranger coming, she will run into the nearest patch of bamboos or bananas, and put one on before she appears in his presence.

There is a tree common to Java, Ceylon, and Africa, which is sometimes called the silk cotton tree. It produces pods containing kapok, a silky white floss which is used for weaving and also for stuffing beds, cushions, and pillows. In western Africa grows the bolobolo, a flowering shrub, whose fibers are somewhat like jute; and the Japa-

nese have a small tree, the paper mulberry, from whose bark they make the finest of paper and a cloth like corduroy. They also weave it with silk.

In New Zealand there is a plant of the lily family which affords a fiber stronger than hemp; and in Brazil within the past few years, has been discovered a weed which has the qualities of both linen and hemp. This is called the Brazilian linen plant, and it looks somewhat like our Kentucky hemp. It is now being cultivated in different parts of Brazil. It grows easily, and in four or five months reaches a height of twelve or more feet. After cutting, it sends out shoots, so that three harvests can be had the same year. It is said that every part of the plant can be used, and that its best fibers are equal to those of fine linen; the second best compare favorably with those of coarse linen, and the third with hemp, while the refuse can be manufactured into writing paper.

New Zealand flax is quite different from the flax of our country or Europe. It is really not flax at all, but is obtained from the leaf of a lilylike plant, sometimes called the flax lily. Its leaves are two or three inches wide and from two to six feet in length; and they are composed of a fiber both fine and strong. The fiber was used long ago by the Maoris (mä′ō-riz); and the English who inhabit New Zealand to-day are cultivating it and extracting the fibers for export, as a weaving material.

There is one more important vegetable fiber, which comes from the husk of the cocoanut. This fruit, as it grows on the tree, has a great hull made up of countless cords or rough hairs which run this way and that, binding it tightly about the nut. If the cocoanuts are picked before they

are quite ripe, the hulls may be broken off and the waste matter taken out of the fiber. This is done by burying the hulls in pits of water. They soon rot, and after a time the woody material can be beaten out with short heavy clubs. The fibers are then washed clean and dried. They are now known as coir, and are ready to be shipped to the mills in different parts of the world. Coir is perhaps the roughest and coarsest of all fibers. It is spun into twine and cordage, and is woven into mattings, sacks, and nose bags for horses. Coir ropes are strong, and they are often used upon ships, and about the decks and quays.

Opening cocoanut burs.

10. ANIMAL FIBERS. WOOL

"Baa, baa, black sheep, have you any wool?
Yes, marry! have I, three bags full;
One for the master, one for the dame,
And one for the little boy who lives in the lane."

TO-DAY we take up a new class of fibers which are used for clothing in nearly all parts of the world. Those we have so far seen have all come from plants or trees;

they are a part of the vegetable kingdom. This class belongs to the animal kingdom. It consists of the hair of sheep, goats, and other animals, and of the fine silky threads which certain worms spin out of their bodies. We have all worn both wool and silk, and we know that they are largely employed in making clothing of one kind or another. Of the two, wool is the more important, and we shall examine that first. We shall also devote most of our travels to learning about that class of wool which forms the hairy covering of sheep, taking a look later on at the comparatively small amount we get from goats, camels, alpacas. When the word *wool* alone is mentioned, we always think of sheep's wool, and we shall use the word in that sense in this chapter.

Dorset ewe.

The value of wool for clothing was discovered before history began to be written. We read of it in the Bible. Abel was a keeper of sheep, and Rachel was watering her father's flocks when young Jacob met her at the well and fell in love with her. The coat of many colors which Jacob gave his favorite son, Joseph, was probably woolen; and it was the shepherd boy, David, who left his sheep in the wilderness, and, with his sling, threw the stone that killed Goliath, the giant.

The ancient Greeks worshiped Pan as the god of the flocks; and among their legends is that of the golden fleece of ram's wool which the young prince, Jason, captured from the terrible dragon who guarded it. Jason's adventures are interestingly described in Hawthorne's "Tanglewood Tales," which I advise you to read.

We know that wool was used by the ancient Romans, and that it formed the chief clothing of Europe at the time of the Middle Ages. In the days of chivalry the noblest ladies worked at the loom, and it is said that King Alfred's mother was a skillful spinner. During that period the finest wool was grown in England and Spain; and as the Netherlands was the chief weaving center, most of the English wool was sent there. After a time, however, the weaving industry sprang up in Great Britain, and it now goes on there and all over Europe.

Southdown ewe.

After our hemisphere was discovered and began to be settled, sheep were carried across the ocean to America. Columbus brought a few with him on his second voyage in 1493, and the Spaniards took some to Mexico, Central America, and the West Indies. Those left in Mexico gradually increased, and, making their way northward, formed the beginnings of the immense flocks that are now found

in southern California and other parts of our West. The English settlers brought sheep to Virginia and New England, and the Dutch introduced them into New York. At the time the War of Independence was ended, there were about ten million sheep in our country, and wool was spun and woven in many of our forefathers' families. The same family often reared the sheep, spun the wool into thread, wove the thread into cloth, and cut and sewed the cloth into garments for its own use.

Our first woolen mill was built by John Pearson of Rowley, Massachusetts, along about 1643; and later similar mills were established in Connecticut, Rhode Island, Virginia, and Pennsylvania. When George Washington became President, he ordered enough broadcloth for a suit of a mill at Hartford, Connecticut; and it is said that he made his first speech to Congress dressed in that suit. Since then our woolen industry has so grown that we now have thousands of factories devoted to it; and we have so many sheep that we produce several hundred million pounds of wool every year.

At the same time a great wool-growing industry has sprung up in other parts of the globe. There are millions of sheep in Canada and Mexico, and such enormous numbers in South America, Australasia, and South Africa that they together supply a large part of the wool used by mankind. The wool crop of the world now ranges between two and three billion pounds a year. About one fifth of it comes from South America, mostly from the basin of the Plata, and almost as much from Australasia, the greater part being from Australia itself. About one sixth of the whole is from Asia and Africa, a large portion

coming from the southern part of the latter continent. Europe raises more wool than any other grand division, producing one third or more of the world's crop. As for North America, it annually grows about one ninth of the whole, and almost all of that is from the United States.

Before starting on our trip to the chief wool-growing regions, we might, if we had time, take a run over the earth to look at the many kinds of sheep here and there upon it. In such a trip we should find sheep in Central Africa which grow hair instead of wool, and might learn that the negroes often make pets of them, and that they follow their masters about, coming at call as our dogs do. In the Rocky Mountains and Kamchatka there are wild sheep, each with two big horns; and in Iceland and northern Russia are some which have four or five horns. In northern China, on the edge of Mongolia, and also in the Libyan Desert in Africa, there are sheep with tails which are masses of fat. They are so heavy that it is said the natives sometimes make little sleds to which they harness the sheep, so that each carries around its own tail on a sled. Egypt has brown sheep; and Europe and our own country have certain varieties which are all white, excepting their faces,

Rocky Mountain sheep.

which are black or dark brown. There are many domestic sheep with horns, and many that have no horns at all. In some parts of France, and also in Hungary, Bulgaria, Italy, and Greece, sheep are kept for their milk, from which cheese is made; these sheep are milked just like cows, and a good one will yield about a quart every day. In New Zealand sheep are bred largely for mutton; and the meat is frozen and carried by the shipload in cold storage to London.

In such a trip about the globe, we should be more interested in the wool-growing sheep than any of the others, and we shall find them most numerous in the great wool countries already mentioned. Such sheep come mostly from well-known breeds, whose wool has been famous for generations. There are long-wooled sheep, such as the Leicesters, Lincolns, and Cotswolds, which produce a coarse wool, sometimes over twenty inches in length; there are medium-wooled sheep, like the Downs, Shropshires, and Horned Dorsets, whose wool is shorter and finer; and more important than all, are the various breeds of Merinos that produce wool shorter still, but of such a nature that it is used more than any other to weave into cloth.

Lincoln ewe.

The chief breeds of long-wooled and medium-wooled sheep came first from England, but they are now reared in our own and in most other countries. The Merinos originated in Spain, where for a long time they were owned only by the kings and nobles, who would not let other countries have them; and it was on this account that Spain long controlled the fine wool trade of the world. Then small flocks of Merinos were given as presents to the rulers of other nations. From time to time a few were smuggled out, and a little more than one hundred years ago, they began to be exported. Those sent away were carefully bred by their new masters, and as a result, the Merino is now found in all the chief sheep-growing countries. A flock of three hundred, which was given long ago to one of the German princes, formed the beginning of the great wool industry of Saxony. Others which were carried to South Africa started the big flocks there; and some of their descendants were taken to Australia, where they formed the beginnings of the vast wool industry of that continent. The Spaniards sent the Merinos to Argentina, and many were imported into Mexico and the United States.

Merino ewe.

11. WOOL. TRAVELS IN SOME SHEEP-REARING COUNTRIES

WE are starting out this morning on a flying trip to some of the chief wool-growing regions. We shall not stop in the United States or Europe. Our travels so far have been north of the equator, and we should like to see something of the southern side of the globe. Sheep are grown largely on both hemispheres, and there are immense flocks in Australia, Argentina, and South Africa.

We first take a map of the world, and lay out our route. The chief sheep-rearing countries of the southern hemisphere are all south of twenty degrees of south latitude; and in visiting them, we can take a new route round the globe. We shall sail from San Francisco for Australia, and thence skirting the southern waters of the Indian Ocean, go westward to the Cape of Good Hope. From there we can get occasional ships across the southern Atlantic to Buenos Aires, at the mouth of the Plata; and thence sail southward about Argentina, through the Strait of Magellan, and along the western shores of our hemisphere to San Francisco again.

The voyage to Australia is a pleasant one. The Pacific is quiet and the weather is warm. We break our journey at Hawaii and Samoa, spending a day at each archipelago with our tropical cousins, and within three weeks after sailing, are landed at Sydney, the chief wool port of Australia. We see great steamers and sailing vessels taking on wool, as we come to anchor in the beautiful harbor; and meet many wagons loaded with wool bales on our way to

the station. As we ride out into the country, we pass train after train carrying wool into the port, and notice that the bales are piled up about the stations, or are coming in on huge wagons hauled by long teams of oxen.

Loading wool.

We are now far back from the ocean in one of the chief sheep-rearing districts of New South Wales. All day long we have been traveling through immense pasture fields, or paddocks, fenced with wire. Some of them inclose hundreds of acres, and some are so large we can hardly see the fences on the opposite sides. A few have droves of cattle, but most are devoted to sheep, which feed here in vast flocks. In some places thousands of sheep are grazing together. They are scattered over the landscape; they have their heads down and are nibbling at the short rich grass. Over there is a field where several flocks have been collected from different paddocks. Those men on horseback are driving the sheep into one mass, so that they form a moving sheet of dirty white as they go along from one farm to another. Listen a moment! The

air is full of the bleating and baaing of the lambs and their mothers.

One of the principal squatters, as the Australian farmers are called, has invited us to visit him and spend a day or

". . . thousands of sheep are grazing together."

so at his sheep station. He meets us with riding horses, as we step from the cars; and we enjoy our long gallop down the wide road. We look in vain for the barns and haystacks so common at home, and our squatter friend tells us that the climate is so warm here in Australia that the sheep can graze out-of-doors all the year round, and there is no need of storing up feed for the winter.

By and by we arrive at the station headquarters. It consists of many low one-story buildings, roofed with galvanized iron; they are the houses of the squatter and of the

men and boys who take care of the sheep. This farm contains thousands of acres; and it has so many people working upon it that they form quite a village, although the inhabitants are almost all men. It has a store, a carpenter shop, and a smithy where the horses are shod. It has great stables, warehouses for wool, and large sheds for shearing. There are also arrangements for dipping or

Dipping sheep.

bathing the sheep in a poisonous mixture to free them from insects and diseases. The station has its managers and its overseers, and also clerks and bookkeepers. An account of everything is kept, and the establishment is managed as carefully as a great store or factory.

We find that the squatter lives quite as well as we do at home. His house has many rooms, all on one floor and most of them opening out upon porches. There are grounds near it for cricket, tennis, and croquet; and we

enjoy several games with the children of the family before the night falls.

The next morning we take horses and go with the men for an all-day ride over the ranch. It is miles in extent, and the fields are so large it would take us an hour or so to walk around one of them. The sheep are all kept in fenced paddocks instead of being herded as are our sheep of the far West. Nevertheless, the great ranch must be carefully watched. It has its boundary riders, men who go about it on horseback every day to see that the fences are in good order, and that wild animals and other enemies do not get at the sheep.

In one part of the station we find men shearing. There are several hundred men at work cutting off the soft thick greasy wool, with shears made for the purpose. As the sheep come in they are of a dirty gray, but as they scamper away shorn they look like bundles of snow upon legs, and each seems clad in a new coat of white velvet.

As soon as a fleece is cut off, it is handed over to sorters who separate the wool into the different grades in which it is baled up for the market. In some other stations the fleeces are rolled up, as they come from the sheep, and sorted by the buyers at the ports or at the factories.

At this same farm we see men shearing sheep by machinery. The sheep is held down by the man while he runs over its body a little clipper like that which the barber uses in cutting one's hair close to the scalp. The power is electricity or steam, and it is conducted by a tube to which the clipper is attached. As the clipper moves over the sheep's body, two sets of knives fly back and

forth like those of a mowing machine. They move at the rate of several thousand strokes per minute, and cut off the wool as smoothly as a hot knife cuts through butter.

The squatter tells us that a man can shear about one hundred sheep in a day whether he works with the ma-

Shearing sheep by machinery.

chine or by hand, and that he pays his men at the rate of five cents per sheep. He says that machine shearing is better than hand shearing, as by it the wool can be cut closer and there is less danger of injuring the sheep.

Before leaving we have several hunting excursions with the men, and spend some delightful days shooting rabbits and kangaroos. Both of these animals are great enemies of the sheep; for they eat up the grass and destroy the

pastures. We hunt the kangaroos with dogs; but they go so fast, leaping over the ground twenty or thirty feet at a bound, that it is almost impossible to catch them. Many kangaroos are taller than a man, and some can outgallop our horses.

It is different with the rabbits. They are found in large numbers, and by driving them together we are able to kill hundreds in a day. They are a much greater pest than the kangaroos; for they breed so rapidly that if not destroyed they will soon eat up all the grass, and the sheep will starve. It is largely on account of the rabbits that the fences are made; and we learn that rabbit-proof fences have been put up along the borders of some of the provinces of Australia to guard against these little animals which we prize so highly as pets.

Leaving our squatter and his fellows, we again take the train and make our way southward to Victoria, and thence cross into South Australia to the seaport of Adelaide, seeing great flocks of sheep here and there all the way. Australasia has all told about one hundred million sheep, and the most of them are found in the eastern and southern parts of Australia. The dry climate and the grass seem fitted for producing fine wool. We see some sheep which have such heavy fleeces that their whole bodies, and even their legs and eyes, are covered. We are told that a prize sheep will yield twenty, thirty, or even forty pounds of wool in one year, although the average fleece is usually seven, eight, or nine pounds and sometimes less.

At Adelaide we take passage in a steamer bound for London by way of the Cape of Good Hope. Our cargo is wool, and the captain says he will carry it all the way

to England at the freight rate of one fourth of one cent per pound. Now it takes just about four pounds of wool to make a suit of clothes for a man, therefore the wool for a suit is carried that enormous distance for one cent. Think of carrying a suit of clothes more than halfway round the world for a cent!

But our vessel is now rolling too much for such calculations. The Southern Ocean, as the sea between Australia and South Africa is sometimes called, is a stormy one and we are tossed about all the way. Our steamer is slow, the voyage lasts over two weeks, and we are glad when we round the Cape of Good Hope and come to anchor under Table Mountain in Table Bay. After resting a while at Cape Town, we take the cars and ride out through the country. Most of the lands are high and dry, and in many places sheep and goats are reared in great numbers. Some of the ranches are ten or fifteen thousand acres in extent, and the farmers often keep flocks of ostriches and goats as well as sheep. The goats are raised for their wool, and some millions of pounds of mohair, as this goat wool is called, is produced in South Africa every year. We find the methods of handling the sheep and wool, however, about the same as those of Australia, and are soon back at Cape Town and on our way to Argentina.

Here we land at Buenos Aires, a city of more than 1,500,000 people and another great port for wool shipping. Argentina alone has over seventy million sheep, largely Merinos; and Uruguay and southern Brazil have also vast flocks. Long-wooled sheep thrive in the Falkland Islands and even in Tierra del Fuego south of the Strait of Magellan. In the Falklands there is a grass which makes the

Load of wool, Argentina.

sheep so fat that if they fall down and roll over on their backs, it is almost impossible for them to get up again. They lie there and kick, until the shepherd turns them over. At the same time the vultures watch the sheep, and if they discover one in this plight, they swoop down upon it and pick out its eyes. If not driven away, they will keep on picking, until the sheep dies, when they will tear its flesh from the bones. For this reason the shepherds watch the sheep carefully. They almost live with them.

There are but few towns in the Falklands, and the homes of the shepherds are so widely scattered that the children cannot have public schools. There are traveling schoolmasters instead. These teachers go from one shepherd's family to another, remaining with each a week or so and then riding on. They leave directions as to what the children are to study during the month or so of their absence. When they return they examine their pupils, and give them a period of teaching again.

In Argentina, as in Australia and South Africa, sheep are pastured out-of-doors all the year round. They are usually kept in large flocks, watched by shepherds and dogs. The shepherds live in mud huts, far out on the pampas. They move about upon horseback, and rely on their dogs, which are often Scotch collies, to do the rough work. The dogs often seem more intelligent than the masters. They will go hither and thither at a motion of the hand, and they obey the shepherd almost as though they really understood human language. They round up the sheep and keep them from straying; and a motion will send them across the prairie to bring in a flock.

As we pass through the Strait of Magellan, calling at Tierra del Fuego on our way back to San Francisco, the shepherds there tell us that they have to protect their flocks from the panthers, vultures, foxes, and wild dogs. They say that the savages will sometimes sneak in at night and steal hundreds of sheep. The vultures pick out the sheep's eyes if they fall down, and the foxes, which are almost as big as wolves, will drive the sheep into the streams and drown them. The wild dogs attack them in packs of twenty or thirty, and the savages, who steal a small flock at a time, will eat what they can of the number and drown the rest.

We have seen that the sheep of other countries have other pests, and as we go on with our tour along the Pacific coast of South America, we read of the kea, or sheep-eating parrot, of New Zealand. In some way or other this bird has learned that sheep's kidneys are delicious, and it seems to know, instinctively, how to get them. It fastens its talons into the woolly back of a live sheep, and clings

there while, with its sharp bill, it digs a hole in the animal's side and plucks out the kidneys. Thousands of sheep have been killed in this way.

12. OTHER HAIR-GROWING ANIMALS

IN addition to sheep, there are several kinds of wool-growing or hair-growing animals which we shall examine before we go to the factories where the fibers are woven. The chief of these are goats and camels, and also alpacas and llamas which look so much like small camels that they might be called the pygmies of the camel family.

The most widely used of these fibers is goat's wool. It is grown in large quantities in southern Europe, in northern Africa, and especially in Syria and on the highlands of western Asia. About two hundred miles southeast of Constantinople there is a rocky mountainous country, known as Angora, where there are more goats than in any other part of the world, and where the goat wool is longer, silkier, and finer than that of other

Angora goat.

regions. Angora fibers are on the average about ten inches in length, and they are so fine that it takes five thousand of them, laid side by side, to cover an inch. Angora goat wool is known as mohair. It is usually white, and it hangs down in long curls or ringlets from all parts of the animal's body, almost touching the ground. Mohair brings high prices. The best is worth several times as much as sheep's wool, and there is so much profit in raising it that Angora goats have been brought to America and are now being kept on many of our farms. Mohair is used to make plush and fine dress goods; mohair plush is employed in upholstering furniture and as covers for pillows and sofas. Almost all the chair seats in our passenger cars are upholstered with it.

In our country many of the goats are kept, like sheep, in fenced pastures. In Angora they are watched by goatherds, aided by dogs which are employed rather to protect the goats from wild animals than to round them up or to keep them from straying. Each dog wears a collar of sharpened spikes about his neck to prevent the wolves from biting his throat. The dogs are large and fierce, and they will even attack strange men, if they trouble the goats. Goats are fond of twigs and of the tender bark of trees, and they so delight to browse on sprouts and brush of all kinds that some farmers use them to clear their lands of such vegetation.

Have you ever seen a cashmere shawl? It is made of wool as soft as the finest down; and the wool is so difficult to get that the shawls sell for very high prices. Cashmere wool is the short fine hair which comes from the undercoat of the Tibetan goat. The animal has a long silky fleece,

and at the roots of this, close to the skin, grow these short woolly fibers. They are so small that one animal will yield not more than two or three ounces, and so fine that it takes ten goats to produce enough for one little shawl. After the goat is shorn, this wool is combed out from the rest of the fleece and sold by itself. It is spun by the native women, who then color the threads and weave them by hand. The work is so slow that it takes nearly a year to make one fine shawl.

Goats, as we have seen, thrive in the dry and almost desert lands of the world. It is even more so with the camel, whose home is the desert itself, and also with his pygmy cousins, the alpaca and llama. Camels go wild on the highlands of Turkestan, where they are hunted for their flesh, skins, and wool. They are kept in large numbers in the deserts of Arabia and Sahara and also in Egypt and the Sudan. On the highlands of Asia, and in parts of northern China and in Mongolia beyond the Great Wall, there are huge two-humped camels which have heavy fleeces of thick soft wool. The camels of Arabia and the Sahara have but one hump. In the colder countries, and especially on the Asiatic highlands, these animals grow a long and thick wool which drops off in the summer and is then gathered up and saved for spinning and weav-

Two-humped camel, Mongolia.

ing. In Arabia, in the Sahara, and in other warm latitudes the camels have hair which the natives use for making tents and wearing materials. Camel's-hair cloth is soft and of light weight; it is used for winter dresses, coats, cloaks, and other clothing where warmth is desired.

As for alpacas and llamas, we do not find them in either Asia or Africa. They inhabit the highlands of South America, and are reared only on the lofty plateaus of the Andes. Most of them are found in the Andean highlands at an altitude of two or three miles above the sea. I have seen great flocks of them in Peru, and have traveled among them about Lake Titicaca and other places in Bolivia, where it is so high and cold that the mountain tops are covered with snow all the year round.

Llamas and alpacas, at first glance, look somewhat alike, but they differ in many ways. The llama is much the larger animal, and its wool is the coarser. It is used as a beast of burden and is largely employed as a freight carrier. The alpaca is herded in flocks like sheep, and is of value only for its meat and its thick growth of fine wool, which averages about eight inches in length. Alpacas are shorn every year, and the wool is shipped by the millions of pounds to Europe and America. It is used for fine dress goods.

Llama wool is consumed largely where it is raised. The men cut it off, and the women spin it and weave it into cloth. In traveling over the high plateau of Bolivia, one sees Indian women spinning this wool as they watch their flocks, and in their rude huts of stone, he may find their hand looms on which they make blankets and shawls. The llama is almost everywhere. It walks proudly along,

with its little head high up in the air, and treads the earth as though it owned it. It has a head like a camel, a body like a sheep, and feet and legs like those of a deer. When surprised, it pricks up its ears like a Skye terrier, and seems interested in every new thing it sees.

Llamas are independent little beasts, and they will lie down and sulk if at all overloaded. When beaten or ill-

Llamas.

treated, they will spit at those who abuse them. Their spittle has a vile smell, and it is painful if it gets into one's eyes. The Bolivian Indians are fond of their llamas. They pet them and talk to them; they sometimes dye their wool red, and also tie bright-colored ribbons through holes in their ears.

Another wool-bearing animal which lives far above most of the world is the yak. To see it we should have to cross the Atlantic Ocean and Mediterranean Sea, and go

through the Suez Canal and Indian Ocean to Hindustan, and then climb over the Himalaya Mountains to the highlands of Tibet. There we should find it taking much the same place as the llama holds in the Andes. Like the llama, it is a bearer of burdens, as well as a producer of fibers fitted for clothing. The llama, however, belongs to the camel family, while the yak is a kind of ox, although not like any oxen we find in the lowlands. It is about as big as the ordinary ox, and it has short widespreading horns. It does not low like our oxen, but rather grunts like a pig. The body of the yak is covered all over with a thick coat of silky hair, which hangs down like the fleece of a sheep. It has great bunches of long wool on the forehead, and soft fur on the shoulders and hump. The hair is used to make ropes and tents, and the fur is woven into a fine and strong cloth.

Yaks.

Among the other animal fibers which are used in clothing are the furs of rabbits, hares, coypus, and beavers. These animals are killed and skinned. The hair is then cut off by machinery or by hand, and so treated that it can be used for making fine hats of various kinds. The tall stiff silk hats which men wear are composed of the soft fine fur of the beaver; and the best felt hats are made from fibers grown by rabbits and hares.

13. IN A GREAT WOOLEN MILL

WE are back again in our own country to-day. We have come by train to one of the thriving manufacturing towns of New England to learn how the hairy fibers from the bodies of sheep are turned into cloth to cover the bodies of men. We shall see this best by going through one of our great woolen factories. We have many such in the United States; for we wear more woolen clothing than almost any other people on earth. Each of us uses on the average seven or eight pounds of wool a year. This is so much that if we raised it all ourselves, we should have to keep at least one sheep for every man, woman, boy, and girl of us, including the babies. The truth is, we have not nearly enough sheep to supply our needs, and we therefore import from other countries wool and cloth by the millions of pounds.

But before we go through the factory, let us glance again at the story of weaving. Wool was probably the first fiber that man learned to use. We read of it in the history of almost every nation; and all over the earth, where there are sheep, we find that even the half-civilized people have rude ways of making woolen clothing. The ancient Greeks valued the textile art so highly that Athena, who was their goddess of wisdom, was also the especial patron of weaving. You may remember the story of this goddess and Arachne, the girl, who for her presumption and pride, was turned into a spider.

Arachne was a maiden of Lydia, so noted for making beautiful cloths that the people came for miles around to see her spin, and the nymphs even crept out of their groves

to watch her working at the loom. Like some little girls of our own day, Arachne could not stand praise. She grew very proud and began to feel that no one was equal to her. She even said she would like to try her skill against Athena, and declared that the goddess would not dare to compete with her in spinning and weaving. Upon this Athena appeared. She came first in the disguise of an old woman, and warned Arachne not to trifle with the gods. Arachne, who was at her loom at the time, stopped for a moment and said: "Keep your counsel, my good dame, for your daughters. For my part I know what I say and stand to it. I am not afraid of the goddess Athena, and I should like to see her try her skill with mine."

Athena and Arachne.

"The goddess is here!" said Athena, as she dropped her disguise and stood forth in her splendor. She thereupon ordered wool of various kinds to be brought forth, and sitting down beside the conceited little maiden, spun and wove away in competition with her. And Arachne

did wonderfully well; but she put on such airs and was so insulting that Athena finally grew angry and changed her into a spider, condemning her and her descendants to spin webs for all time to come.

As we look at the great woolen mill before us, we wonder what Arachne would think if she could change again to the form of her girlhood and come back to earth. She might imagine herself on Mount Olympus, and that this huge structure, with its many glass windows, was the home of her gods, and wonder whether the volumes pouring out of its smokestacks were not the breath of old Vulcan. The shriek of the steam from the engine would make her turn pale at the thought of some chimæra or dragon, and the sparks from the dynamos would terrify her when she was told that the thunderbolts of Jove have been harnessed by man to aid him in his spinning and weaving. She could not understand the machines buzzing away inside the factory, nor the processes by which wool is now so rapidly turned into fabrics more wonderful than any imagined when she worked at the loom. She would be so dumfounded by the din and confusion that she might wish herself back into a spider again; and, pulling a long thread out of her mouth, might throw herself upon the mercy of her descendants which have their cobwebs stretched high across the unused corners of this very factory.

And, in fact, we feel somewhat the same way ourselves, as we start on our trip through the mill. Everything is so bustling and busy. Men are wheeling wool to and fro. Outside they are unloading the bales from wagons and cars, and within they are tearing the wool apart and sorting it. Here they are running it through great wash-

ing machines, and there spreading it out on the floors, where it is sprinkled with oil. In many of the rooms strange machines meet our eyes, and we find everywhere new things to learn.

There are hundreds of men, women, and children at work in the spinning and weaving departments, and in other rooms they are milling and fulling the cloth. Here they are pressing and steaming the goods, and there they are packing them up for shipment to the markets all over the world. At first sight, all seems confusion; but we soon learn that the factory is worked by a system, in which every man has his place and everything goes on in its regular order.

We have letters of introduction to the managers of the mill, and they point out many interesting things as we go through. They take us first into the sorting room, and show us a bale of the fibers just as they come from the sheep. We thrust in our hands and pull out a bunch of the wool. It is dirty and greasy, and as we throw it back our fingers shine as though coated with vaseline. We notice that the wool contains sticks, sand, and dirt, and are told that it must be steamed, scoured, and thoroughly cleaned before it will be ready for spinning.

Our friends point to the sorters, who are standing at tables covered with wire netting and pulling the wool from the bales hither and thither. We observe that they throw different kinds into different baskets or crates, and the managers tell us that all wool is classified before it is spun. They show us that wool varies according to the kind of sheep from which it comes, and also according to the parts of the body of the sheep on which it grows.

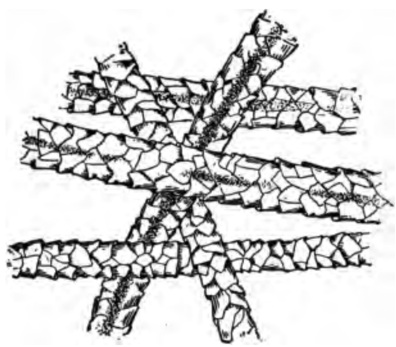
There is as much difference in wool as there is in the hair of human beings. Some races have fine silky hair, while others have hair that is coarse, straight, and wiry; and there is also the kinky wooly hair of the negro.

Sorting wool.

You may have noticed how fine a baby's hair is, and that it grows coarser, as the child grows older. It is the same with wool, the fibers varying in texture as they come from a lamb or yearling or a still older sheep. Wools are different also according to the wave or curl in them; and there are so many things to be considered that we despair of learning them all.

As we watch the sorters, one of the managers brings forth a microscope and asks us to examine the wool of a pure-bred Merino. To the naked eye it appears to be

composed of thin curly hairs; and the men tell us that they are so fine that it would take about eighteen hundred of them, laid side by side, to cover an inch, and that ten thousand are grown on a space as big as the nail of one's thumb. He says that a pound of the finest Merino wool can be spun into a thread about one hundred miles long, whereas some other wools are so coarse that the thread from a pound would not reach more than one mile.



Wool fibers, magnified.

Under the microscope each fiber seems as big around as a lead pencil, and to be covered with sharp scales which overlap one another like those of a fish. The scales are so close together that there are several thousand of them on a single inch of the fiber. The sorter tells us that the scales are important in weaving; for they interlock in the different fibers so that they cling together. In this way the cloth becomes firm, and the wool can be felted or pounded, as we shall see later on.

As we examine the fibers further, we observe that they have a yellowish appearance, and are told that this comes from the yolk or fatty material, secreted by the skin, which covers the hairs. It keeps them from matting together; and it must be removed to make the wool weave and take the dyes. The sorter tells us that the curl or waviness of the fiber also aids in the weaving, saying that the

best wools are curly, and that their curliness is estimated by the number of waves to the inch. He shows us that all such things must be considered in the grading, in order that the right fibers may be used for the right kinds of cloth.

We now leave the sorters, and go on into some hot rooms full of steam in which are many great vats filled

"Here the wool is washed."

with wool just as it comes from the sorters. Here the wool is washed and the grease taken out. Each vat contains a mixture of hot water, caustic soda, and soap, and has machinery which stirs the wool about and scours it, as it goes through. After this hot bath, the wool passes into a milder mixture, and then on into troughs of lukewarm water, where it is thoroughly rinsed, coming out clean and white and free from grease. It is now carried

on into drying machines, and is then opened up by steel teeth so that the thorns, sand, and dirt are taken out. This makes it soft and fluffy, and so dry that it must again be made greasy before it can be woven. This is done by sprinkling it with olive oil.

After all these processes the wool has reached about the same condition as the raw cotton when we saw it entering the carding machines. It is then carded much like cotton, and so combed out, by great wheels covered with teeth, that the short fibers are taken out and the long ones left straight. At the end of this process the wool comes forth in thick soft strands, which are drawn out finer and finer until they are of the right size for spinning.

The spinning is done in much the same way as cotton; and the warp threads are then wound around the beams of the looms and the woof threads upon bobbins so that they may be carried back and forth by the shuttles. The weaving of cotton and of wool is based upon the same principles, and the threads are put together in about the same way.

There are, however, additional processes through which the woolen goods must go before they are ready for wear. They must first be crabbed, to take out the wrinkles and make them lie smooth and straight. They are then fulled. This is much the same as shrinking. It consists of soaking the cloths with hot water and soap in order that the fibers may thicken and draw themselves together, after which they are again pressed between heavy rollers.

If a soft nap is desired, the cloth must be teaseled. The process is called teaseling, and if you can imagine being scratched all over by little hooks which will go just

deep enough into your skin to make it right rough without cutting much into the flesh, you will have some idea of the process which cloth undergoes in order that it may have a soft fuzz, or nap, all over it. The teaseling is done by the head of a thistle raised in Europe for the purpose. The head is covered with fine wiry hooks which become strong when dried, and which, when the heads are fitted into a frame and drawn over the cloth, catch into the wool just deep enough to pull the fibers out into a velvety nap. In this mill we find boys employed to fix the teasel heads into the frame. In many mills the cloth is passed through intricate napping machines which produce the nap by means of wire brushes instead of teasels.

Teasel.

After teaseling, the nap must be sheared off smooth by machinery. The cloth is then brushed, and sometimes wrapped around a huge drum and placed in hot water, being soaked again and again that the fibers may shrink and the cloth be more solid and have a finer luster. There are many processes of finishing woolen goods, according to the cloth especially desired. Some kinds must be more fulled than others, and this is the case with broadcloth. On some goods the surface is smooth, and on others the nap is so heavy that it stands out like velvet.

Farther on we shall learn many other things connected

with cloth making. We shall see how goods are dyed, and how they are woven and printed in colors and patterns. Dyeing is common to both wool and cotton as well as to silk, another important fiber which will form our next field of travel and investigation.

14. SILK, ITS ORIGIN, HISTORY, ETC.

HAVE you ever heard how the silkworm came to Japan? It is one of the best fairy stories of Asia, and every Japanese boy and girl knows it well. It happened long ago, at about the time that Mother Goose lived; when Jack climbed the beanstalk and killed the giant; and Puss in Boots performed such wonders for her master, the Marquis of Carabas. It was during some such period that there lived in far-off India a beautiful little princess who had a stepmother more cruel than that of Cinderella. She whipped her and starved her, and finally tied her up in the hollow trunk of a mulberry tree and threw her into the ocean. It was then that the girl's fairy godmother appeared. She kept away the winds and storms, and watched over the little one, while her mulberry boat sailed away to Japan.


Silkworm moth.

There the boat was swept far up on the shore, and the

little maiden stepped out. The sands drifted over the trunk of the mulberry, and the rich earth from the mountains washed down upon it, so that it took root and became a great tree. It grew blossoms and berries; and from its seeds Japan soon had many groves and orchards of mulberries. The little princess was welcomed by the inhabitants, and so kindly treated by them that, when about to die, she begged her fairy godmother to present some great gift to the Japanese people which should make them always remember her coming. The fairy thereupon turned her into a silkworm, and taught her to eat mulberry leaves and spin silk therefrom. In time she became a moth, and laid hundreds of eggs from which were produced other silkworms, and finally a great silk industry. Japan now makes some of the finest silks of the world, and its little children aid in rearing the worms and in handling the cocoons.

Feeding silkworms, Japan.

Is it not strange that the most beautiful of all our clothing can come from the mouth of a worm; and stranger still, that these little beings can be so reared that thousands and millions of them are kept working away spinning for us? Every

silkworm is a tiny silk mill, whose raw material is the mulberry leaves. It grinds up these leaves in its mouth and digests them into a gum. It then spins the gum forth in a long fine thread, and weaves this into a cocoon. Man takes the cocoon and unravels the thread; and by twisting a number of the cocoon threads together, is able to make the silk we use for weaving all kinds of these beautiful goods.

The common silkworm is a native of China or India. Its scientific name, or rather that of the moth from which it comes, is the *Bombyx mori*, and it belongs to the family of silkworm moths. We have some varieties of this family growing wild in our own country, and there are wild silkworms in Japan, China, and India, which spin cocoons of a coarse silk from the leaves of certain forest trees. The *Bombyx mori* is the domestic silkworm. It lives altogether on the leaves of the mulberry, and it has for ages been reared to supply silk for mankind.

As to who discovered that these little worms could be employed to clothe man, we do not know. The Chinese say that they were first reared for the purpose by the wife of their famous Emperor Huang-ti, who lived about forty-five hundred years ago. That Empress is worshiped by the Chinese under the name of Yuen-fi as the goddess of silk; and every spring, at about the time the mulberries begin to put forth their leaves, the Empress of China makes offerings to her in a temple, in the palace grounds at Peking. It was shortly after Yuen-fi died that the mulberry tree began to be cultivated for its leaves; and soon after that silk weaving sprang up in many parts of the empire. The silk industry became so profitable that it

was long kept a secret. The people were warned not to teach it to strangers, and not to let the silkworm eggs go out of China.

Then, as the story goes, some of the eggs and some seeds of the mulberry tree were concealed in the headdress of a Chinese princess and carried by her to India. The seeds were planted and grew. The eggs were hatched, and the silk moths therefrom formed the beginning of a great silk industry, which eventually spread to Persia.

The eggs were probably carried at an early period from China to Japan. It is said that after many centuries they were smuggled out of China into Europe by two monks who had concealed them in their bamboo walking sticks, and thus brought them to the Emperor Justinian at Constantinople. The monks had learned all about silkworms and silk weaving in China, and were thus able to teach these things to the people.

The silkworm industry gradually spread. It was started in Greece, thence went to Italy and Spain, and at last to central and southern France. All of these countries still rear silkworms; and a great deal of the raw silk now used comes from them, as well as from Asia Minor, southern Russia, and the regions of the Caucasus Mountains.

Now, as soon as the people of Europe learned how to rear the silkworm and to reel the cocoons, they began to weave silk. Before that time, all the silks worn in Europe came from Asia. They were brought in, at great expense, by caravans and ships. Some came by way of Constantinople, some by the ports at the eastern end of the Mediterranean Sea; and, after the route around the

Separating cocoons from their nests.

Cape of Good Hope was discovered, some were sent that way from India and China to Europe. At first silk goods were made in Greece and Italy only, and during the Middle Ages, the Italians became celebrated for their fine silks and velvets. A little later, one of the French kings imported Italian workmen to teach his subjects how to make silks, and a great weaving industry was developed at Lyons which was for years the chief silk city of the world.

In due time this industry spread to England, Germany, and other parts of Europe, until now fine silks are made in many places. A little later it came to the United States, where, as we shall see farther along in our travels, it is now carried on upon a greater scale than anywhere else in the whole world.

But to return to these little worms which we have followed crawling and spinning their way around the globe. They did not stop with France. The eggs were brought into England by King James I; and he, finding the climate of our Mother Country too cold, sent some across to his colonies in America. Some eggs were hatched in Virginia at an early time; and at different periods, others

were sent from England to South Carolina, Connecticut, Massachusetts, and New Jersey.

Silkworms thrived to some extent in all these localities. In Virginia enough silk was produced to make the robe which King Charles II wore when he was crowned; and in Charleston, South Carolina, Mrs. Pinckney spun and wove a silk gown for the mother of King George III, the raw silk of which came from worms reared by her own hands. At one time two hundred pounds of silk were reeled from cocoons raised in Connecticut, and this was made into stockings, handkerchiefs, and ribbons. In 1768, twenty thousand pounds of cocoons were spun in Georgia, and more than one thousand pounds of reeled silk exported. Later still Benjamin Franklin, who was on a mission to Europe, sent home some silkworm eggs and mulberry slips, and after a while a silk factory was started in Philadelphia.

Mulberry leaf and silkworms about ready to spin.

Many of these things happened shortly before the Revolutionary War, and it then seemed that silk raising might become one of the chief industries of our country. The Southern States, however, soon discovered that they could make more money from other crops. King Cotton drove my Lady Silk out of South Carolina and Georgia; and Prince Nicotine, as we might call the tobacco plant,

crushed the life out of her in Virginia. The Revolution destroyed what remained of the industry in the North; and it was not until more than a generation after that war closed that any concerted effort was made to revive it again.

Then in 1830, when Andrew Jackson was President, a great craze sprang up all over the United States about the fortunes that, as the people believed, could be made out of silkworms. The eggs were imported, and many of our farmers set their wives and children to caring for them and raising cocoons. Congress took the matter up and offered special inducements to those who grew silk; and for a time the country went wild over this business. Mulberry nurseries were started, and the young trees were sold at from one to five dollars each. It was soon discovered however that the business was not profitable, and many were ruined.

By these experiments we have discovered that the silkworms can be reared in our country, and some quite learned people think that we have certain localities where the industry may yet be made to pay. Our Agricultural Department is much interested in the production of American silk, and it aids those who desire to enter into it. The rearing of these little beings, however, as we shall see later on in our travels, requires the cheapest of

Raw silk.

labor, the greatest of care, and just the right conditions of climate and food. And therefore, for the present at least, it seems more profitable for our people to import their raw silk from other parts of the world.

15. A DAY WITH THE SILKWORMS

WE are again in China this morning. We have crossed the Pacific Ocean from San Francisco to Shanghai, and are now in a house boat, traveling through one of the chief silk districts south of the great Yangtze River. We have a cook with us, and eat and sleep on board. We stop where we please; and now and then leave the boat and take a tramp on the banks or across the country from one canal to another. Our craft is manned by Chinese who row us along; and who now and then land, and, harnessing themselves to a rope, drag us onward through the narrower waterways. This whole region is cut up by canals. There are but few roads, and the chief footpaths wind their way about the fields and orchards without regard to distance. Here and there, high bridges arch the canals, and from them we can get good views of the country.

The land is flat, and we can look for miles over green fields, dotted here and there by mud villages, and interspersed with countless orchards of mulberry trees. The trees border the waterways. There are millions in sight, and they extend on and on to the horizon. They are grown to supply food for countless silkworms, many of

which are even now in those mud houses, spinning the fibers destined for our silk-weaving mills.

We come down from our bridge, and take a stroll through a mulberry orchard. The trees are nothing like our mulberries, which grow as tall as an elm and are not out of place in a forest. The orchard looks more like a thicket than a grove. The trees are not much higher than our heads; they are as knotty and gnarly as the olive and as ragged as the bush of the quince. They are cut back and trimmed every year, and are not allowed to reach more than six feet in height. They are grown from the seeds in nurseries, and are set out in rows about five feet apart. The trees are carefully cultivated, and the cutting does not injure them. They sprout out again every spring, and continue to yield leaves for about fifty years.

Gathering mulberry leaves, Japan.

In our orchard we find the men and boys gathering the leaves; and we go with them to their homes to see them fed to the worms. We are first shown the *Bombyx mori*, or silk moth, which lays the eggs from which the worms hatch. It is about an inch long, whitish in color with brown stripes on its wings. It lays its eggs in the sum-

mer, on sheets of white paper, which are hung up in a cool place until the following spring. When first laid, the eggs are yellow, but they soon become green and afterwards black. Our Chinese friends show us some which were laid last year and are now ready for hatching. What curious things! At a distance they look like fly specks upon the sheets. They are no bigger than pin heads, and are so light in weight that it takes thirty-five or forty thousand of them to equal an ounce. It would take almost a half million to weigh one pound. Each moth lays from four hundred to seven hundred eggs, and soon afterward dies. If the eggs are kept cool, they can be carried anywhere, and they are often sold at so much per ounce. The Chinese store them away, and allow them to hatch the following year when the tender young mulberry leaves are just right for food.

Our next sight is the silkworm just hatched. The sheets of eggs have been laid between cloths and placed in a warm room for eight or ten days when the tiny hairlike silkworms appeared. Sometimes they are laid between the bedquilts and hatched by the heat of the sleepers, and more often in cloths next the skin inside the clothes of the women of the family. Before hatching, the paper on which the eggs lie is dusted with the ashes of mulberry leaves and with lime and salt. As soon as the worms are born, they are sprinkled with millet bran and given a meal of tender mulberry leaves, chopped very fine. As they grow older, they are fed with pieces of leaves, and finally they eat whole leaves.

The worms are great feeders. An ounce of eggs will produce enough worms to eat about a ton of leaves during

their short lives. They are fed five or more times in one day, and eat most at night.

The silkworms grow rapidly. At first they are so small that they can easily crawl through a pin hole in the white paper on which they are hatched, and a paper full of such holes is usually laid over the egg sheet in order that the worms may crawl through. The little ones do this to get at the light, and also at the mulberry dust on the top sheet. In this way they become less crowded on the paper; and in going through they scrape off any bits of the tiny eggshells which may have stuck to them.

The worms eat almost steadily for eight or ten days, and then go to sleep for forty-eight hours. During their sleep they eat nothing, and when they wake they are ravenous. They then eat for a few days and go to sleep again, taking four long sleeps before they become caterpillars. After each sleep they cast their skins, and come out with new ones.

The silkworm is full grown at the age of thirty-two days. It is then the color of amber and has entirely changed its appearance. When hatched, it seemed a little fine hair and was small enough to have been coiled within a pin head; now it is a caterpillar about as big around as one's little finger and is almost two inches long.

We can hear the worms eating as we go into the feeding rooms, and the noise of their spinning sounds like a gentle rain. Our guide warns us again and again to be quiet. The little worms are sensitive and will not thrive if offended. They do not like strangers, and visitors are seldom permitted to see them. Everything connected

with them must be kept clean. They do not like the smell of smoke, wine, vinegar, or tobacco, and will not tolerate oil or musk. Such girls of our party as have perfumery about them are not allowed to come near, and we are told they dislike scents of all kinds.

The spinning of the cocoon is most interesting. At this time the worms stop eating, and crawl upon a bridge or pile of straw placed on the paper for the purpose. Then each spits from its mouth some gummy silk which sticks to the straw; and it then begins to spin the little oval house in which it hopes, if such a tiny being can hope, to go to sleep and awake a moth. It doubles itself up like a horseshoe and sways its head to and fro, as it spins out the thread from the silk glands, which, like two long sacks, run down each side of its body. The silk comes out of openings in its upper lip in two threads which become one as they leave the mouth.

The worm first throws the thread about loosely to form the floss or outside of the cocoon; and then, hanging itself up, it spins all about its body, moving its head this way and that. Within less than a day it has disappeared from view, and within three days its new home is completed. The inside is not spun round and round in regular order, as one might suppose, but in the shape of figure eights or in loops, first in one place and then in another.

When the cocoon is finished, it looks much like a great white or cream-yellow peanut, covered with fuzz. The total length of the thread so spun is almost two miles, although the portion that can be recovered by reeling is only from one twelfth to one half as long. The rest is used as floss or waste silk.

Cocoons.

Under the microscope the silk fiber seems double. It is like a glass rod with a groove in it; and we can distinguish two strands which are twisted together as they leave the worm's mouth. The fiber is glossy and exquisitely beautiful. It is so fine that from six hundred to eleven hundred cocoons are required to make a pound of raw silk; so that every silk garment we wear must have required the work of at least one thousand silk worms. I think I am safe in saying that there is not a ribbon worn by a girl in our party which does not contain the life work of at least one hundred or more of these little beings.

After the silkworm has finished its cocoon it goes to sleep; and, if left as it is, in the course of eighteen or twenty days, it crawls forth a moth. In doing so, however, it must first soften the end of the cocoon with its saliva and make a hole in it. This injures and often breaks the fiber. Therefore the silk farmers allow only such worms to become moths as are needed to lay eggs for the next crop. The rest, and this means nearly all,

are killed in their cocoons by steaming, boiling, or baking. Great care is taken not to make the heat so intense as to injure the silk; but the worms must be killed to preserve it in all its beauty. After this the cocoons can be dried and kept for months. By some farmers they are brought to the markets for sale; and by others are reeled at home, and the thread is sold by weight as raw silk, or it may be spun and woven by the people themselves upon their rude looms.

Weighing raw silk, Japan.

The business of raising the cocoons is extensive. It is carried on in China and Japan and in other parts of Asia, and also in Europe. In Italy, for instance, more than one hundred million pounds of cocoons are produced every year. In most of these countries and elsewhere, the silk fiber is reeled from the cocoons and sold as raw silk, in which shape it forms one of the great commercial products of the world.

Raw silk often comes to us packed in linen with an outer covering of matting. The bales are very small in comparison with cotton. They are usually square, and each contains a number of bundles of nine or ten skeins each.

16. REELING AND WEAVING SILK

MOVING lazily along in our house boat, we stop now and then in one of the villages, far out in the country, and watch the people reel the thread from the cocoons. This work is usually performed in the lands which rear the silkworms, either by the farmers on little hand reels, or in great factories or filatures made for the purpose. As spun by the worm, the fiber is so fine as to be unfit for thread or cloth making; and the object of reeling is not only to unwind the cocoons, but also to join the threads of three, four, five, or more of them into one continuous strand. This must be carefully done, as the price the silk brings depends much on how it is reeled.

In most places the cocoons are first sorted according to their color and size, and also as to the quality of their fibers. The white and yellow ones are put by themselves, and those dead or moldy are thrown aside to be worked up as floss or waste silk. Then the outside of the good cocoons is brushed off, and a half dozen or so of them are thrown into hot water. As they soften, the fibers become loose and can be picked up and put through the eyelet of the reeling machine. When the right number have been caught, the machine is started and the long fibers, spun by several silkworms, are twisted together into the thread known as the raw silk of commerce.

Let us tramp across the fields over the path between those two big mulberry orchards to that mud village, and see just how the reeling is done. Those yellow-skinned boys, in blue gowns, with their hair braided in queues or

tails down their backs, who stand on the bank, will gladly act as our guides. Their parents will probably sell us some raw silk to take home.

We are first shown how the cocoons are sorted and cleaned, and then watch the women as they reel off the fine strands. The weather is pleasant, and they work out-of-doors. Each woman sits close to a frame to which a

"They work out-of-doors."

large wheel is attached. Her little feet are on a treadle, and by pressing them down she makes the wheel fly around.

But look! a cocoon thread has broken. Observe how deftly the woman fastens another to it, and the reeling goes on. When the thread is finished, it must be of equal thickness and brightness throughout. Our Chinese friends tell us that a good workman can reel only about a pound and a half in one day.

Our next stop is at one of the great silk filatures, such as are common in France, Italy, and other parts of Europe where silkworms are reared. Many are now being established in China and Japan. We can visit one of the largest

in Soochow on our way back to Shanghai, and there see how silk is reeled by machinery. The establishment stands right on the banks of the Grand Canal. It is a huge brick building of two stories, covering several acres. It looks not unlike one of our big cotton factories. It employs more than a

Reeling silk by machinery, Japan.

thousand women and girls, and reels great quantities of silk, which are packed up in bales and shipped away to our country and Europe.

Our boat takes us to the entrance of the filature, where we are met by the Chinese directors. They are tall fine-looking men, dressed in bright-colored silk gowns which fall from their necks to their feet. They speak English, and tell us much about their business, as they go with us from one room to another. We start in at the basement, where huge steam engines, made in America,

are supplying the power which moves the machinery; and then we ascend to the warerooms to look at the great piles of cocoons just as they have come in from the country. They are white and yellow, each covered with a soft silky fuzz. The cocoons have already been baked, and the silkworms inside are cooked hard. We pick up a handful. They look and feel like peanuts, and are of about the same size; and the little dry worms rattle like kernels inside the shells.

In another room we watch the girls cleaning the cocoons and then go on into the reeling department. Here the machinery is humming like that of a big woolen mill. There are hundreds of women sitting behind the reels, which are moved by steam. In front and below them are pans of hot water, in which the cocoons are bobbing about, as their fine white fibers unwind and go twisting into the thread that is being wound on the reels. We are told that it takes five cocoons to form the finest thread of raw silk, and that the grade imported by the United States usually contains six, eight, or ten strands.

Much of the work in the factory is done by small girls. Most of the little ones, who stand around the hot pans stirring the cocoons with brushes of bamboo, are younger than we are; they cannot be more than eight or ten years of age. Nevertheless, they work twelve or thirteen hours every day, and all the week through. Their wages are less than one cent an hour, and some small girls get less than five cents for a whole day's steady work.

Going farther on through the filature, we see the silk taken from the reels. It is first put up in skeins and bundles and then packed into bales, each weighing a picul, or

one hundred and thirty-three pounds. Some linen cloth is then sewed about each bale, over which must go an outer covering of matting, before it is ready for shipment. A great deal of the silk made here is sent to New York, which port takes more of this material than any other in the world except Shanghai. We buy millions of pounds of raw silk every year, and the most of it comes from Japan and China, the two chief silk-producing countries of the world.

Leaving Soochow, we go in our house boat back to Shanghai, and there find that a steamer is about to start with a cargo of raw silk and other goods to New York by the Suez Canal. We take passage and sail southward, calling at Singapore, Ceylon, and Port Said. We then cross the Mediterranean Sea; and, steaming out through the Strait of Gibraltar go over the Atlantic Ocean to dear old New York. There we watch the men landing the silk, and then follow the bales as they are carried by train to the city of Paterson, New Jersey, hard by.

Paterson is our chief silk-weaving city. It is situated on the Passaic River, near falls which give it good water power; and it is close to New York, which is our largest silk market. We have all together more than five hundred silk factories, situated chiefly in our Eastern States and mostly in New England and New Jersey. There are more in Paterson than anywhere else. That city makes about one fourth of all the silk goods woven in the United States. Its mills annually turn out so many ribbons that, if all were fastened end to end, they would stretch farther than we have traveled in our long journey from Shanghai to New York; and so much silk dress goods and handker-

chiefs that one year's product would carpet a path a yard wide from New York almost to San Francisco. We are now weaving over one hundred million dollars' worth of silk goods every year, and are rapidly advancing as a silk-manufacturing nation.

Our silk mills have machinery equal if not superior to those of Europe, only a very small proportion of our silk goods being made upon hand looms. In Asia the most of the silks are still manufactured by hand. There are many thousand rude silk looms in China; and beautiful goods are woven in huts not much better than those where we saw the silkworms. It is the same in India and Japan, although both countries have now modern silk mills; and so, also, with the important silk cities of Lyons and St. Etienne in France, Krefeld in Germany, and with some other cities in Europe.

Chinese woman weaving.

The silk factories of Paterson are in many respects not unlike the other weaving mills we have visited. Women and girls are largely employed, and a maze of fine machinery is buzzing away. We watch the bales as they arrive, and see the silk taken out and conditioned, in order

that its value may be properly estimated. Raw silk is peculiar in that it will take up water to an amount almost one third its own weight, and therefore it is carefully weighed before it is bought. The conditioning, which is done by machinery, shows just how much moisture it con-

In a Paterson silk mill.

tains. It is performed by taking a sample and heating it until perfectly dry. After this the loss of weight is noted, and the value of the silk is calculated therefrom.

The first process of preparing the silk for weaving partakes of somewhat the same nature as that of cotton or wool. Although the silk fibers are reeled into one long strand and do not have to be carded or combed out and straightened, they nevertheless must be cleaned and freed from all imperfections. The process of cleaning is called throwing, and the workmen who do it are the throwsters.

The skeins of silk are first wound upon spools or bobbins, and then are unwound and passed between plates so graduated that any bit of dirt or lump in the thread catches, and stops them as they move through. The throwster removes any such imperfections, and at the end they come out doubled and twisted into yarn of different sizes, according to the uses for which they are intended. The thread is now boiled and scoured to take away the coating of gum on its surface, and is then dried again. The next process is dyeing, after methods which we shall see farther on in our travels; and then comes the putting of the silk on winding frames, each consisting of revolving spindles or small wheels which are connected with spools.

After the thread is spooled, it is rewound for the warp and the woof. The machines for the warp have wooden wheels about ten feet in height, some of which are thirty-six inches wide. The threads are wound regularly around these wheels, as many threads being used as will make the width of the cloth. If the warp is for ribbons, only a few are required; but if it is for silk goods thirty-six inches wide, as many as twelve thousand threads may be needed. At the same time, in another machine, the woof threads are wound upon quills so that they can be put into the shuttles and thrown across through the warp from side to side, just like the shuttles in weaving cotton and wool.

When the silk is woven, it must go through a finishing process. All knots, dirt, and stains must be removed, and the nap singed off. The goods are then sprinkled with a preparation of wax or gelatine, and run through a series of steel rollers, which give them a gloss. They are now folded or wrapped upon blocks, and are ready for the market.

In addition to these processes there are many others, some of which differ according to the character of the fabric. If a soft silk is desired, the goods receive one treatment, or if the demand is for rustling silk, such as is sometimes used for petticoats and dress linings, it goes through another. A changeable silk is made by using a warp of one color, with a different colored filling, as, for instance, a black and green; and there are various ways in which the colored silks are put together to form the many kinds of goods and patterns sold in our stores.

17. DYEING AND DYESTUFFS. WEAVING IN PATTERNS

THE weaving we have so far examined has been devoted to goods of one color only. To-day we shall see how cloths are woven in patterns and in the many colors common to ribbons, dress goods, and other fine stuffs used for clothing. Cotton, linen, wool, and silk have been dyed for ages. We have all read in the Bible of the coat of many colors which Jacob gave his boy Joseph, and Moses tells us that the ram's skin used for the Tabernacle was dyed red. The purple of ancient Tyre was so beautiful that the kings of that country made it the royal color, and it has been continued as such from then until now. Alexander the Great is said to have brought the art of coloring goods black, yellow, and green into Greece from India; and when our hemisphere was discovered many new dyestuffs, such as logwood and cochineal, were found.

To-day the whole world is called upon to contribute the

colors of our clothing; and our dyes come from the animal, vegetable, and mineral kingdoms. The famed Tyrian purple was from a shell animal or fish, found in the Mediterranean Sea, but it was displaced by a cheaper vegetable dye of the same color made of the orchilla weed, so named from Orchillini, an Italian, who discovered it. This, in turn, is now being crowded out by still cheaper dyes made from coal tar.

Some of our most brilliant scarlets and crimsons are from the cochineal insect, which feeds on certain plants of the cactus family. These little beings are so small that it takes seventy thousand of them, when dried, to weigh a pound; and the work of gathering them from the cactus is so tedious that a person can pick only a few ounces a day. After picking, they are killed by roasting, baking, or boiling, and can then be saved for an indefinite time. The cochineal of commerce came originally from Mexico, and it is now also produced in the Canary Islands and in other warm parts of the Old World where the insects have been carried. Cochineal is so costly that it is not so much used as other and cheaper materials which yield the same colors.

Another insect which supplies a dye much like cochineal is the lac, which lives on the milky juice in the bark of the fig trees of certain parts of Asia. It is gathered by the natives, and great quantities of it are exported to Europe.

The vegetable dyes are many. They come from plants and trees, some wild and some cultivated. We have all heard of indigo which furnishes the blueing employed in clothes washing. This is made out of plants that are largely grown in India, Java, and other parts of Asia. It is one of the chief dyestuffs of commerce. The

indigo plant is somewhat like ragweed, and it grows to a height of from three to five feet. It is raised from the seed. When ready to flower, the plants are cut off close to the ground, tied up in small sheaves or bundles, and placed in vats of water. As they become soaked they begin to ferment; the water turns yellow, and it then runs off into other vats, where it is stirred for several hours. After a while the color changes to green, and a little later blue flakes rise to the top. This is the indigo. It begins to settle as the men stop stirring, and when the water is drawn off, it can be dried and pressed into cakes for shipment to the dye factories all over the world. In some places the leaves, from which the best indigo comes, are stripped off and thus treated, the plants being left to grow a second and sometimes a third crop before they are cut. Indigo is used in dyeing cottons and woolens, and the cotton clothing of the poor of India, Egypt, China, and Japan is often so colored.

Among the principal red dyes of the vegetable kingdom are those made from Brazil wood, sandalwood, madder, and safflower. Madder comes from the roots of a plant grown in Europe; and safflower, from the blossoms of a thistle of India, China, and also France, Spain, and Egypt. The sandalwood tree grows in southern Asia, and especially on some of the islands of the Dutch East Indies; and the Brazil wood tree in Brazil and other hot lands of South America. In using the woods as dyestuffs they are cut into chips or ground to a powder, and the coloring matter is then extracted by boiling or by allowing them to ferment until the dye is soaked out.

We get a valuable yellow dyestuff, known as quercitron

(kwer′sit-ron), used in calico printing, from the inner bark of an oak tree which grows in our Eastern and Southeastern States, and other yellows from the berries of a thorn bush of Persia, and from the seeds of the annotto shrub which is found in South America and Asia. There are many plants, shrubs, and trees, grown in different climates, which produce various dyestuffs, yellow, red, green, and brown, so that a single piece of our bright-colored cloth may contain the vegetable products of many far-away parts of the globe.

Even more important than the dyestuffs which come from animals and vegetables are those we now extract from certain minerals, and especially from coal tar. Coal tar is the thick black liquid that condenses in the pipes when gas is distilled from coal. In this state it looks sticky and dirty; and one would not think it could be so treated, in combination with other chemicals, as to form nearly all the colors of the rainbow. It is so however, and great factories, devoted to making aniline colors, as these dyes are called, have sprung up in our country and Europe, and more especially in Germany. Such colors can be produced far more cheaply than those made in other ways.

Suppose we take a run across the Atlantic Ocean to Europe, and visit one of the largest of the factories which make aniline dyes. There is one in Germany, near Frankfurt am Main, which employs more than two thousand hands. It has over twenty acres of enormous buildings, with high smokestacks above them. Everything about it is dirty, and the air is laden with bad-smelling odors. The passageways between the buildings are filled

with tubs and hogsheads of curious compounds; and dye-stained men are mixing these together to form the combinations needed for the various colors.

Here, they are lifting great barrels of liquid and pouring it into vats, which are already half filled with materials of another color. There, they are stirring the stuff together by machinery, which, in connection with steam,

Mixing dyes.

makes the whole seethe and bubble like a witch's caldron. As the new ingredients flow in, the color changes. It may be black at the start, and turn to a light yellow, a brilliant scarlet, or, perhaps, a sky blue. The workmen know just how much material of each kind is needed; and they also realize that if there is too much or too little of any one kind, that whole pot of dye may be spoiled. In such works everything must be done exactly right. The colors

are first made by chemists, who test all the materials and see just how much of each must be used to form the right hue. They are always experimenting on new colors and tints, and on how to make the old combinations stronger and better. The dyes of this establishment are not only used by the German cloth-making factories near by, but are shipped to the other countries of Europe, to the United States, and, indeed, all over the world.

Returning to our weaving mills, we find that most of them have dyeing departments connected with them, and that the cloths are treated in many different ways in order that they may become the beautiful goods sold in our stores.

In some fabrics the fibers are dyed before spinning, in others the thread is dyed, and sometimes the cloth is put through the dye vats after it has been woven. Before dyeing the fibers must be cleaned to remove all impurities, and, where light and delicate tints are desired, they must be bleached. In dyeing cotton it is first boiled in weak lye and then rinsed. It is next steeped in diluted sulphuric acid, and then again washed and dried. Raw silk must be boiled in soapsuds to remove the gum which the worms leave upon it, and then bleached by passing it through the smoke of burning sulphur. Wool is washed in hot suds to get out the grease, and it is then bleached by a treatment with sulphur. So we see much must be done before the dyeing begins.

The dyeing itself requires great care in order that each thread may be of just the right color before it goes into the cloth, or, where the whole cloth is dyed, that it may be of the same color throughout.

We find the weaving of the colored threads into cloth wonderfully interesting. The rooms where it is done are bright with the gay hues of the thread; and the looms are different from the ordinary power looms we have already seen. In the past, such weaving was slow and difficult, and each loom required several different people to operate it. Now, by the invention of a Lyons man, Joseph Marie Jacquard, the most exquisite colors and patterns can be put together by machinery. The weaver has a card of little squares that shows him just how the colored threads are to go, and there is a combination of large cards and of needles or wires by which the loom turns out the pattern desired. This invention was made by Jacquard more than one hundred years ago, and among the first pieces of cloth woven by it was a robe of magnificent brocaded silk for Josephine, the wife of Napoleon Bonaparte, then Empress of France. Now the Jacquard loom is used everywhere in Europe and in the United States, and cottons and wools, as well as silks, are woven upon it.

Jacquard loom, Paterson.

In our travels through the mills we observe the weavers making goods in raised patterns by changing the threads

of the warp and woof. We see others making goods of mercerized cotton, which have the finish and gloss of silk. In this work the threads have been soaked in a solution of alkali and stretched. We are shown how velvets are made by weaving the silk upon wires and then cutting the threads so that a soft and smooth nap or pile is left; and we are shown ribbons of gay colors turned out upon Jacquard looms by the thousands of yards.

Weaving ribbons.

Some of the finest ribbons come forth beautifully embroidered. In France they are often woven over glass rods, and the shuttles of the little looms fly back and forth like things of life. Many ribbons are of velvet, and some have flowers and birds raised in satin on a soft silken ground. Others are woven of gold or silver thread, and some are as gorgeous as a peacock's tail.

It is the same with the more costly silks, and we learn that designs and patterns have to be drawn for all such

goods before the looms can be arranged for them. This is true of all cloths other than those absolutely plain, so that designing and pattern making is quite a business of itself. In both Europe and our own country there are schools where boys and girls learn to make designs for the weaving mills and where they are taught the arts of fine weaving and pattern making.

Later on we are shown how cloths are printed or stamped in different colors. This is done by running the finished goods through great roller presses, engraved with the patterns, and fed with the various dyestuffs required. Almost all calicoes are made in this way, and also many of the cheaper colored linens, woolens, and silks.

18. KNITTING. THE STORY OF THE STOCKING

SO far our travels have been concerned with the important fibers of commerce, and with the weaving of the threads spun from them into clothing materials. To-day we shall see the threads put together in a different way. In weaving, they are first divided into two sets, the threads of the warp and those of the woof; and these are plaited in and out, and over and under one another as in the making of a mat. The processes we are now to investigate relate to garments made by means of one thread only, the work being known as knitting.

We have all watched our mothers and grandmothers knitting stockings, mittens, and other such things. Some of us have worn tam-o'-shanters made of wool, and many

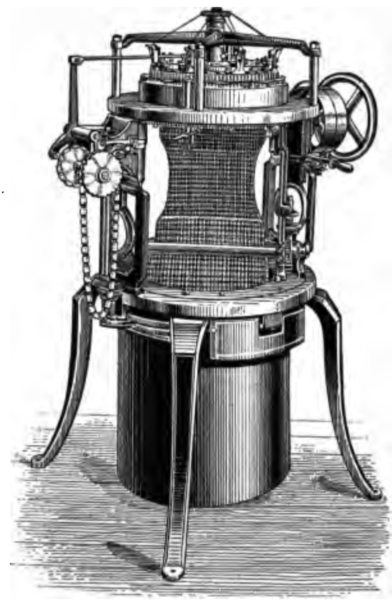
of our girls have had, I dare say, knitted caps as bright colored as that of Little Red Ridinghood. When out sledding or skating on an icy cold day, there is nothing equal to mittens; and no stockings will keep one's feet so warm as the thick woolen ones knitted by hand. Formerly all the stockings used in our country were made at home. Girls were taught to knit about as soon as they could hold the needles; and at the time of our Revolutionary War, many of our girls of eight or ten years were able to make their own stockings and mittens. The young women of that time made such things to sell; and every woman was supposed to have knitting needles in her hands when she was not doing something else.

Knitting.

This is the condition in many countries to-day. In some parts of Europe the old men of the poorer classes knit; and the Scotch shepherds, watching their flocks, make stockings as, aided by their collie dogs, they keep the sheep in order.

Knitting is supposed to have been invented in Scotland. That country is cold and damp in the winter and warm clothing is needed. The people had stockings made of skins and cloth long before the invention of knitting.

After knitting was invented such garments grew more and more popular. They came into use throughout England, and gradually found their way across the Channel to France and to other parts of Europe. The letters of Queen Elizabeth show that she once wore cloth stockings, and that she was greatly delighted when one of her subjects knit her a pair of stockings of silk, saying that she would wear no other kind thereafter.



A knitting machine.

Knit goods soon grew so popular that men began to invent machines to make them. It was during the reign of Queen Elizabeth that William Lee invented the stocking frame, by which knitting was done by many needles all working at once. The queen praised him for his ingenuity, but refused to grant him a patent. She also discouraged the use of the machines, because, she said, they would take away the means of living of many of her poor subjects who were making stockings by hand.

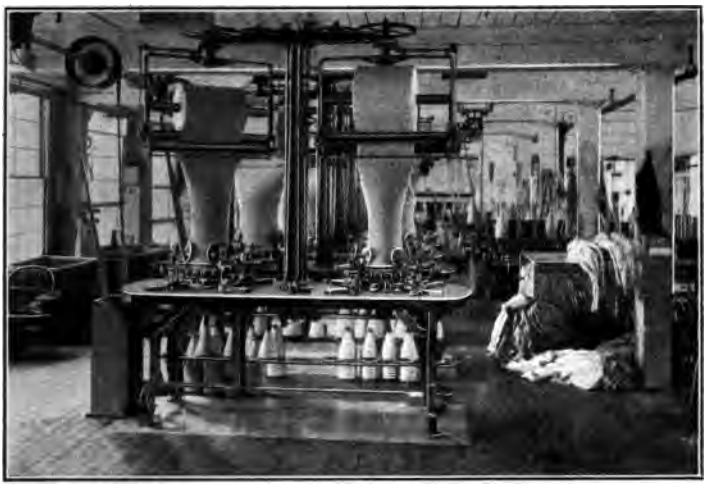
After that there were other inventions for the production of various kinds of knit goods, and along about 1816

the first circular knitting machine was made. A few years later steam was applied to such machinery, and now there are great factories in this country and Europe which knit not only stockings, mittens, and caps, but all sorts of underwear, and jerseys, sweaters, and garments of almost every description.

In modern machine knitting all sorts of materials, from the finest silk to the coarsest wool, are employed, and the product is enormous. During the year that our last census was taken, our knitting mills used about one hundred and thirty-two million pounds of cotton yarn, while the silk thread employed for the same purpose was worth more than a million dollars. We now make about one hundred million dollars' worth of knit goods every year; and we have tens of thousands of men, women, and children employed in our knitting factories. We annually knit a vast number of socks and stockings, and enough cotton shirts and drawers to supply two suits to every man, woman, and child in our country, and have many to spare. There are great knitting factories in Europe. Those of England employ more than one hundred thousand hands, and France alone produces from twenty to thirty million pairs of stockings a year.

We might visit such factories in many parts of our country. We should find the machinery far different from that of the spinning and weaving mills, and it is so complicated as to be difficult to understand without seeing it. The stitches are made by the machines in much the same way as in knitting by hand, although they are more perfect and even, a large number of needles being used for each article. A small-sized stocking, made of fine

yarn, is knit in a cylinder, containing about sixty needles; and if the stocking is to be larger, more needles are used. In starting the work the knitting begins at the top of the stocking, and the leg is shaped by a regulator by which it can be made larger or smaller without stopping. There is another arrangement which enables the knitters to make



In a knitting mill.

the heel of a double thickness if desired, and also to knit the foot and finish the toe before the stocking is taken out.

For knitting other goods there are machines of different shapes and sizes, and also special arrangements for making ribbed goods. Ribbed stockings are usually worn by children. In these the leg is first knit by a machine which has from one hundred and twenty to two hundred and forty needles; and the legs are run out in a

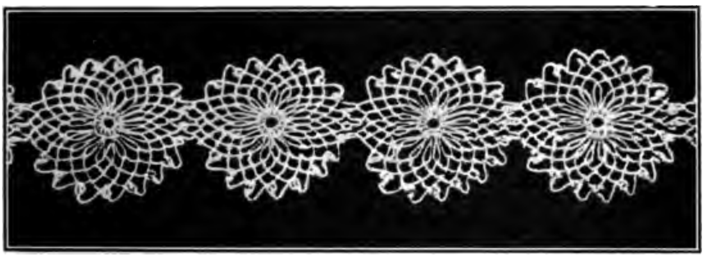
continuous strip which is afterwards cut into pieces according to the lengths desired. After this each leg is placed upon another machine, which takes up the work and knits on the foot. In this last process the toe is left open, and it requires still another machine to complete it. The stockings are now dyed, and then finished by passing them through a machine in which the fuzzy fibers are singed off. They are then dried and pressed, and put up into packages, ready for sale. Some of the finer stockings are knit flat and seamed up the back; while the ordinary grades come from a single machine, which does all the work but closing the toe.

In knitting underwear there are many more operations. The yarn or thread is first wound upon bobbins, and is then knit into the fabrics by hundreds of tiny needles which go at a lightning speed. The thread from each bobbin passes through a guide which takes it on to the needle, and the woven cloth comes out of the bottom of the machine in a continuous stream. The bodies of the garments are shaped on large knitting machines which make them wide at the shoulders and narrow at the waist. The sleeves are knit on smaller machines, and are afterwards sewed to the bodies, at the rate of thirty-five hundred stitches per minute. There are also machines to form the buttonholes, to sew on the facings and bindings, and still others to cover the seams.

After the underwear is completed, it is finished by pressing it between steel plates which are kept hot, or by running it between heated cylinders. It is then stamped, labeled, and packed up ready for shipment to the stores.

19. AMONG THE LACE MAKERS

HOW should you like to make lace? If you lived in some parts of Europe, you might learn to do so in connection with your regular school work. There are districts in France where this art is taught in the public schools, and where the girls work away with their needles day after day, stitching at these beautiful fabrics. In Greece



Made in a lace school in Ireland.

the queen has established schools for teaching lace making. Ireland has many such schools; and they are to be found also in certain districts of Italy, Germany, Belgium, and in some other countries.

Lace making might be called the artistic department of our world of clothes. Laces are for ornament only. One would freeze to death in our winter, if compelled to dress in lace garments. Nevertheless, laces are so much used that millions of women and girls, scattered over the world, do nothing else but work at making them by hand; and great factories have been built wherein trimmings, edgings, handkerchiefs, shawls, and other lace goods are produced by machinery.

Several different countries claim the honor of having invented the process of making lace, but no one knows just which came first. Italy produced beautiful lace goods shortly after America was discovered, and the lace of Venice was famous for several centuries thereafter, and even to-day old Venetian lace is considered most beautiful. After Italy, Spain began to produce fine laces, stitching patterns of flowers, leaves, and other designs, thread by thread, with a needle; and then along in the sixteenth century, a German woman, named Barbara Uttmann, invented a process of making lace upon pillows, which soon came into general use.

In the manufacture of pillow lace the pattern is first drawn on parchment or paper, and then fastened to a cushion by pins, which are stuck in at regular intervals along the lines of the pattern. Now a large number of threads, each attached to a bobbin, are twisted or plaited around the pins, so as to form a network, carrying out the design. By moving these threads in and out through the pins, and crossing and recrossing them over and under one another, the workers are able to make figures of leaves, flowers, and all sorts of beautiful things. When the parchment is taken away, the fabric alone remains; and it is often so beautiful that the costliest and finest of dresses are trimmed with it.

All pillow lace is made by hand; and it is the same with needle-point lace, which is worked upon loose threads, laid upon a previously drawn pattern, and afterwards joined together by needle and thread. In making this lace the design is usually drawn upon paper, to which a piece of heavy linen is stitched that it may be held straight.

Then, the first threads are laid along the lines of the pattern, and sewed lightly down to the parchment and linen. After this, the entire figure is carried out with fine work, many thousands of stitches being required for a single piece of the most beautiful goods. When the pattern is completed, the linen is cut from the paper, and the lace work may then be removed.

"All pillow lace is made by hand."

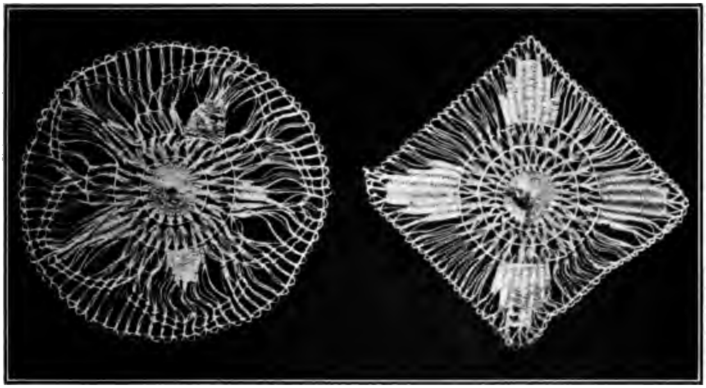
Suppose we cross the Atlantic Ocean from New York to Antwerp, and take a trip through some of the lace-making regions. We shall start in with Belgium, and go thence into France. Belgium is noted for its fine linen, and also for its beautiful laces. The flax grown in the fields is spun into thread, and the women make the lace in their homes. We see them everywhere, sitting outside their houses with pillows on their knees, stitching away. Many small girls are at work, and we are told that the children begin to learn the art at the age of five or six years, and that by ten they are often able to produce most beautiful goods. It takes a long time to make lace, however, and if a girl can earn but a few cents a day, she is happy.

Going southward into France, we find many lace makers.

". . . sitting outside their houses with pillows on their knees."

Hand-made lace is produced all along the northern coast and some most beautiful goods are stitched upon pillows in the upper part of the valley of the Loire river. The most of this work is done in the homes of the people. The French are sociable and are fond of working together; in fine weather eight or ten girls and their mothers will bring their lace out under a large tree or in the shadow of a house, and stitch away as they chat. Each has a cushion on her knees, to which a pattern is attached; and her fingers and tongue go equally fast.

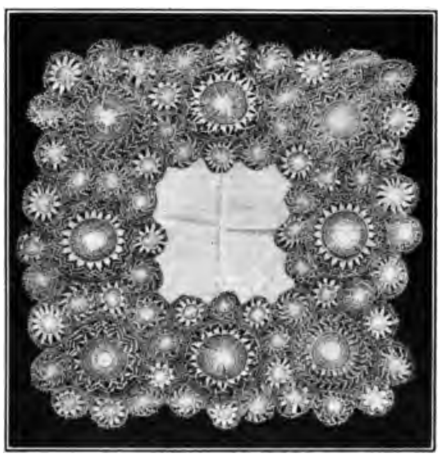
We might travel on through Spain and Italy, and observe the same business carried on there; and should we cross the Mediterranean to the islands of Malta, we might see thousands of girls making handkerchiefs and collars and cuffs in silk and linen lace. The people of the Madeira Islands knit beautiful lace, and some exquisite patterns are produced by the women of Paraguay, Mexico,



Teneriffe wheels from Madeira Islands.

and even of far-off Japan. Russia is noted for its hand-made laces, and so are Germany and Norway and Sweden.

Lace goods are so much desired that if they were all made by hand it would be impossible to supply the demand; and moreover, hand-made lace is so costly that only the rich can afford the fine patterns. By the invention of machinery, however, beautiful lace goods can be manufactured very cheaply, and they are now pro-



Lace handkerchief from Paraguay.

duced in large quantities in many parts of Europe. There are factories in Switzerland, France, and England, which are noted for their fine laces, and from which we import many millions of dollars' worth of goods every year. This is so of Nottingham in England; Calais (kä-lā') and Lyons in France; Plauen (plou'en) in Germany, and St. Gall in Switzerland, as well as other places. Nottingham makes wonderful lace curtains, a single pair sometimes costing as much as five thousand dollars. Lace goods are made in all widths, some not so wide as your little finger nail, and others large enough to cover the broadest bedspread.

Calais has more than four hundred lace factories, some containing machines so heavy that it would take twenty-five horses to haul one of them across the country on wheels. Nevertheless, these mighty machines make the most delicate laces. They turn out many handkerchiefs, veils, and collars thinner than gauze and lighter than feathers.

In Plauen over seven thousand machines, some worked by hand and some by steam, are employed in lace making; and in St. Gall there are factories which keep thousands of Swiss women busy manufacturing embroideries and edgings for the United States markets. I doubt not that some of the girls of our party are now wearing goods that were made at Calais, Plauen, or St. Gall, and that many of our homes are hung with curtains from Nottingham.

A look at the map of Europe will show just where these lace makers are working. If we should go there and enter one of the factories, we should find the hum of the machinery quite as great as that of our own spinning mills. For the finer designs, Jacquard pattern cards are attached to the machines, and an almost endless number

of bobbins are required. The work is so complicated that we do not attempt to describe it, except to say that it takes many men, women, and girls to tend the machines; and that the goods must be bleached and finished before they are packed for shipment across the ocean to us.

Machinery has so reduced the cost of lace manufacture that almost every woman and girl now wears more or less lace. Along about the beginning of the last century, when Thomas Jefferson was still President of the United States, the best Honiton lace was so expensive that a lady's veil of the finest quality sold for as high as five hundred dollars. A little later, by the bobbinet machine, similar goods were made so cheaply that a veil could be sold for two dollars. Any one of the great lace factories of to-day turns out thousands of square inches of net in one hour; and Nottingham and St. Gall now make enough lace every year to form a wide band of edging around the coasts of our country and leave something to spare.

20. LEATHER

"One misty moisty morning,
When cloudy was the weather,
I chanced to meet an old man
Clothed all in leather;
Clothed all in leather
Up to the chin.
How do you do? How do you do?
And how do you do, again?"

THE time was when mankind was dressed almost altogether in the skins of wild animals. It is true that Adam and Eve wore fig leaves, but had the Garden of

Eden been afflicted with our winters, they might have taken the warm fur of the seal, or deprived the cow of her skin to keep out the cold. At any rate, it is sure that their descendants soon learned the value of skins for clothing.

We read of skins being used in the earliest ages. There are engravings on the tombs of the Egyptians, who lived at about the time the Pyramids were built, which show that they had processes of tanning; and pieces of leather have been discovered in China which are said to be more than three thousand years old.

We know that the ancient Greeks appreciated the value of leather. Homer speaks of Hercules and the lion's skin which he always carried about over his shoulders; and when Dido, the queen of the Phœnicians, laid out Carthage, she bought for the site of her city as much land as a bull's hide would cover and tore it into strips so that it might include a large tract. The ancient Romans knew about leather, and they tanned it with a mixture of oil, alum, and bark. People were using it at the time of Christ, for the Bible says that when Saint Peter came to Joppa, he stopped at the house of Simon the Tanner.

In the Middle Ages and long afterwards, leather was an important part of the clothing of both men and women. It was not an uncommon material for breeches in the days when our forefathers came to this country. The Indians were wearing leather at the time that America was discovered, and when the first settlements were made in New England, New York, and Virginia.

Many of the inhabitants of the uncivilized parts of the world are even now wearing garments of this material.

The Lapps clothe themselves in reindeer hides, and the Eskimos of Greenland and Alaska are clad in skins cured with the hair on. In Tierra del Fuego and the other islands about the Strait of Magellan, I have seen the natives clad in but little more than the furry skins of the guanaco, with which they now and then cover their shoulders; and in the heart of Central Africa, about Lake Victoria, I have met women, dressed in cow-skins rudely tanned, with their naked babies tied up in calfskin bags which were slung to their backs.

"... dressed in cow-skins rudely tanned."

The first skins used by man were probably cured with the hair on; and it was some time before the art of preserving them without this was discovered. With the hair on, the skins of animals are usually known as furs; and it is only when the hair has been taken off and they are properly cured that they become leather. It is with leather that we shall first deal, leaving our investigations of furs to other journeys which we shall take later on.

Our leather industry is much more important than that of our furs. Its products sell for several hundred million dollars every year; and it employs many, many thousands of people. The leather making of the United States is carried on in more than forty thousand different establishments, and tanneries are to be found in almost every part of our country. There are great leather manufactories in New York, Pennsylvania, and Massachusetts, and also in Maine, Ohio, and Illinois. The cities of New York, Boston, Philadelphia, and Chicago are the chief markets for their products.

We use so much leather that our own cattle, sheep, and other animals cannot supply the skins needed, and there are ships continually coming in from different parts of the world bringing materials of this kind to us. We are always importing great quantities of hides from South America, and especially from the cattle regions of the basin of the Plata. We buy hides from Africa; and goats by the thousand are reared on the northern edge of that continent that their skins may be sold to the United States for making kid shoes. We have people all over the world who are always gathering such materials for us. Away down in Australia they are hunting kangaroos, whose skins will be used to make the uppers of certain kinds of the boots and shoes which we manufacture; and in southern Africa men are shooting alligators in order to sell their skins to our leather makers. We import the skins of dogs, rats, and sheep for gloves, deerskins for slippers, and fine calfskins for caps.

It is hard to number the many kinds of animals which go into the articles which we daily use. We have parts of the ox, cow, and horse always under our feet, for their

"We buy hides from Africa."

hides sole our boots. If the skin of our shoe uppers could speak, it might bleat of the calf from whose back it came; and if the fine leather footgear of our small children could do likewise, it might voice forth a series of baas about the sheep and lambs from which much of such leather is taken. From our gloves we might hear the bleating of kids or the barking of dogs; and, as we ride about on horseback, from beneath us might come some terrible grunts, for saddles are made of pigskins. If all the leather about us should speak in the language of the animal world of which it once was a part, the voices would form a confusion of tongues equal to that about the great Tower of Babel. Certain of our shoestrings would puff out their thoughts in the blowing of the porpoise. The belts around our waists might voice forth the hiss of the snake, the babylike cry of the seal, or the horrid grunt of the great crocodile. There would be a neighing and

Our leather industry is much more important than that of our furs. Its products sell for several hundred million dollars every year; and it employs many, many thousands of people. The leather making of the United States is carried on in more than forty thousand different establishments, and tanneries are to be found in almost every part of our country. There are great leather manufactories in New York, Pennsylvania, and Massachusetts, and also in Maine, Ohio, and Illinois. The cities of New York, Boston, Philadelphia, and Chicago are the chief markets for their products.

We use so much leather that our own cattle, sheep, and other animals cannot supply the skins needed, and there are ships continually coming in from different parts of the world bringing materials of this kind to us. We are always importing great quantities of hides from South America, and especially from the cattle regions of the basin of the Plata. We buy hides from Africa; and goats by the thousand are reared on the northern edge of that continent that their skins may be sold to the United States for making kid shoes. We have people all over the world who are always gathering such materials for us. Away down in Australia they are hunting kangaroos, whose skins will be used to make the uppers of certain kinds of the boots and shoes which we manufacture; and in southern Africa men are shooting alligators in order to sell their skins to our leather makers. We import the skins of dogs, rats, and sheep for gloves, deerskins for slippers, and fine calfskins for caps.

It is hard to number the many kinds of animals which go into the articles which we daily use. We [illegible] parts of the ox, cow, and horse always under our [illegible] for [illegible]

"We buy hides

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Out of our tanneries come all sorts of leather. The walrus, the seal, and the alligator, as well as the cow and the pig, furnish the material for traveling bags; some kinds of belting are made from the hides of the hippopotamus; and it is not uncommon to tan the skins of

Drying hides, Argentina.

lizards and moles for handbags, purses, and other small things. The Japanese have lately been curing frog skins and making pocketbooks of them; while far off in Africa, where the rhinoceros and the elephant live, the skins of those huge beasts are made into leather, which is sometimes cut into strips for whips and for other articles in which great strength is required. The chief leather used in commerce and manufactures, however, is that of cattle, sheep, and goats, the other kinds being of only minor importance.

Let us visit one of the tanneries to see how leather is made. As the skins come from the animals, they rot

easily; and, if dried, they soon become hard and coarse and unfit for use. By converting them into leather they are so changed that they will last a long time; will be porous and flexible, and just right for our various manufactures. In making leather, only a part of the skin is used. When first taken off, it consists of two layers, the outer of which, containing the hair, is hard, rough, and without blood vessels. It is of the inner or true skin that the leather is made. This is composed of gelatinous fibers, which can be so treated, by means of tanning, that it becomes soft and flexible and fitted for such clothing as shoes and gloves.

The different cuts of a cow-hide.

Here we are at the tannery. We could easily recognize it by the odor, even if those huge wagons loaded with hides were not standing before it. The hides give forth a horrid smell, and this is not improved by the odor from the great pits and vats in which the hides are being turned into leather.

We enter the building and walk about, stepping carefully that we may not fall into the vats. One of the bare-armed tanners thrusts in a hook and pulls up a skin in order that we may handle it. It was put into the vat only a short time ago, and is still slimy and dirty and covered with hair. Its first bath is merely to soften it and take off the dirt; it will next be soaked in a solution of lime to loosen the hairs. In a room near by we see men cleaning and fleshing the hides which have been taken from the

vats. They stretch them upon wooden horses, and by means of long knives scrape off the hair and outside skin, leaving only the leather. They are paring down the hides, as it were, and cleaning them.

The next process is tanning. This is done by soaking the hides in a liquor which prevents their decay and fits

Vats in a tannery.

them for leather. The change is produced by the tannin in the mixture, a material which comes from the bark of certain trees and the leaves of certain plants. In our country the most common bark employed is the hemlock, and the most common leaf is the sumach. In other countries, oak bark is largely used for this purpose, and there is also an acorn which is excellent for tanning.

The hides are placed in the vats between layers of some such tanning materials. Water is then let in upon them,

and they are allowed to soak there for months. When they have become thoroughly tanned, the mixture has gone through and become a part of them, and they have been changed from hides into leather. They are now taken out and dried. They are pressed between huge rollers, and the finer leathers are rubbed smooth with pumice stone. After this there are processes of dyeing and finishing, according to the character of the leather, and the uses for which it is intended, so that it takes a long time before the skins are ready for use.

The processes we have just seen belong to the older tanneries. Within recent years, inventions have been made by which the work can be more quickly done. In the new methods, various chemicals are used, the most important being chromic acid, the process being known as chrome tanning. By this means, leather can be made within a very few hours; and we learn that a large part of the kidskin used in our boots and shoes, is so turned into leather.

In addition to these methods, skins are sometimes cured by tawing. This means treating them, after removing the hair, to baths of bran and water and also of alum; and then covering them with a paste made of flour and the yolks of eggs mixed with water. The eggs go into the pores of the skin, and the leather is cured by them. It is now dried and again moistened, and after that it is pulled backwards and forwards to stretch and soften it, and finally it is smoothed with a hot iron.

Chamois leather, most of which comes from sheepskins, is prepared in much the same way, save that at the end of the cleaning it is treated with oil instead of eggs. The oil works into the skin, giving it a soft, spongy nature.

Tanned leathers differ, not only according to the skins used, but also to the methods by which the tanning is done. Morocco leather, which formerly came almost altogether from North Africa, is now prepared in the United States from imported goatskins. It is always dyed on the outer side, and is so finished that it has a ribbed or roughly grained surface. Russia leather is tanned with birch-bark. This gives it a peculiar odor, which moths and other insects do not like, and makes it especially valuable for bookbindings. Japanned leather has a bright, shiny coating or enamel, which is produced by varnishing the skins after tanning, enabling them to take the brilliant polish of our patent leather shoes.

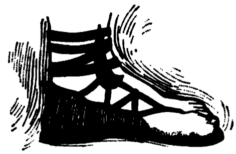
Cordovan leather comes from horsehides; it gets its name from Cordova, in Spain, where it was first made. Most of the hides are from the wild horses of certain parts of South America, only a small portion of the skin of each horse being used.

21. THE WORLD OF SHOES

"I'm little Goody Two-Shoes,
With two shiny new shoes;
Let everybody look,
For I want them to be seen.
Listen to them creak!
Hear their funny squeak!
Do you wonder that
I'm proud as any queen?"

WE are starting out this morning on a new sort of travel. We shall imagine that each of us has drawn on a pair of boots like those of the giant in the

fairy tale, which enabled him to make seven leagues at one step. Only our boots are more wonderful still; for they will enable us to go at a jump from continent to continent, to tramp over the oceans and to encompass the whole world in the space of one morning. We wish to learn about the footwear of many different nations, and to see some of the odd boots and shoes of far-away lands. Later on we shall return home and investigate the shoe industry of our own country, where are the largest and best factories of the world.



Roman shoe.

We have no record as to just when man began to wear shoes. Where the climate was warm, he probably started with sandals, consisting of a sole of wood or skin tied to the leg or ankle with strings. In colder lands, he probably used moccasins, clothing his feet in bags of soft hide, which he cured in one way or another.

Chinese woman's shoe, nineteenth century.

We know that the Egyptians, Greeks, and Romans all had some protection for their feet. There were shoemakers in ancient Greece. In mythology, we learn that Jason lost his sandal by carrying an old beggar woman across a stream, when on his way to the court of King Pelias; and that, when he appeared there, he came in with one foot bare and was then sent by the king on his mission to capture the Golden Fleece from the terrible dragon. The story is cleverly told in

Greek sandal such as Jason wore.

Nathaniel Hawthorne's "Tanglewood Tales." The Greek women wore boots, with ornaments fastened about their ankles; and the Romans had fine leather shoes, some white and some dyed red, scarlet, yellow, and purple.

Venetian slipper.

At an early period man began to decorate his foot gear with silver and jewels. Caligula, the Roman emperor, had his shoes studded with pearls. Buckles were used long ago, and once when Sir Walter Raleigh appeared at the court of Queen Elizabeth, he wore boots ornamented with jewels which cost six thousand pounds. During the reign of Richard II of England the nobles had shoes so long that the toes were held up by gold and silver chains attached to the knees, and shortly after that their shoes were so wide that they measured six inches and more over the sole.

Boot and spur, Middle Ages.

In our country, shoes are made only of leather. For ages the foot gear of Europe was of both leather and wood; and to-day wood, cloth, and straw are used for such wear in many parts of the world.

Early English boot and spur.

But our magic boots are waiting to hurry us onward. Our first jump shall be across the Pacific to the land of Japan. We are in the heart of one of the Japanese cities, and can hear the clatter of the shoes as the people go


Japanese shoe shop.

along the streets. Many of them wear wooden sandals held on by strings, which fit in between the first and second toes. Some have leather pockets at the front of their sandals into which the toes go, the instep and heel being bare; and others have sandals on legs so as to keep their feet well up out of the mud. Those are the rain shoes of Japan. Notice those two men pulling that cart. Their legs are bare from the instep to the knee, and their feet are protected by sandals of straw.

In China we observe that the people have on great shoes of black cloth, with white soles of wood an inch or more thick. Some of the men have on cloth boots, and many have shoes of satin and silk. There are some boots of leather; but as a rule most of the foot gear is of other materials. We see the Chinese cobbler mending shoes on the street. Out in the country we find men, women, and children in straw sandals; and, here and there in the cities, pass stores where ladies' fine shoes are displayed for sale. Some of them are of bright-colored silk, embroidered with silver and gold. They are so small we can hardly put our fists in them. Such shoes are intended for the little feet of the Chinese ladies, which

Chinese lady's foot.

until recently were bound up from infancy so as to keep them as small as the feet of our babies.

Crossing over to Manila, we find our little brown cousins of the Philippine Islands wearing straw shoes and sandals of wood; although some now have on foot gear like ours. We see them in use in the various islands of the Dutch East Indies, and also in Siam, Burma, and Hindustan, although many of the poorest people there go with bare feet.

From India we climb the Himalayas to Tibet on the highlands of Asia. We are now so far up in the air that it is cold; and both men and women wear large boots, some of which are made of yak's hide and others of lambskins and sheepskins with the wool on the inside. Many of the Tibetans have their boots tied with wide leather strings about the legs at the top.

Moving on eastward, we reach Persia; and thence we go on to Turkey and other parts of the Mohammedan world. Here the men wear low shoes or slippers of bright red or yellow leather. Their foot gear has no heels, and

the leather at the back is often turned down under the foot so that the shoes flop up and down as they go.

In these countries, as well as in Japan and some other places, one always takes off his shoes when he enters a house or a temple. The Mohammedan considers it wrong to wear his shoes into church; and the soft white mats which cover the Japanese floors would soon be ruined were they trodden by coarse foot gear like ours. The Turkish women have slippers which are beautifully embroidered. They are made of bright-colored leathers, and the more costly ones are covered with gold and silver thread. In Turkey both men and women sometimes have under-boots of soft leather reaching up to the knee. They are usually worn inside large shoes, and when traveling or in the house may take the place of slippers.

Jumping the Bosporus and going northward, we see the richer people of Europe clad in leather foot gear much like our own. In Russia and other parts of southeastern Europe the men prefer top-boots even in summer, and in cold weather the women also wear boots. Many of the Russian peasants have straw shoes, and also felt footwear which looks clumsy. In the winter some have boots lined with fur; and along the Volga the Tartar women have long stockings of bright-colored leather, sewed together in patches.

In Germany and France wooden shoes are worn by the poorer classes, and the same is true of the Netherlands, where both old and young may be often seen going about in thick clogs. The climate of Holland is moist, and the ground is generally wet. The wooden shoes keep out the dampness; and, although they look heavy, they are by no

'The wooden shoes keep out the dampness.''

means so bad after all. The little Dutch children run about in clogs almost as well as we do in our light shoes of soft leather.

Leaving Europe, we now cross the ocean to the United States and again place our feet on our leather-shod continent. We have been clear around the world, but we have nowhere found the people so well clad as at home. In our country there are but few who cannot afford shoes; and, as we go on, we shall see that we make and wear more shoes and better shoes than any other nation on earth.

22. A WALK THROUGH A GREAT SHOE FACTORY

AMERICAN foot gear is noted all over the world. Our boots and shoes are sold in every continent, and are more or less used by every civilized people. We lead all other nations in the invention of shoemaking machinery,

and our factories stand at the head, in the quality and extent of their product. They use so much leather that all the animals reared on our farms cannot supply them; and they employ more than two hundred thousand men, women, and children in turning out boots and shoes, by the hundreds of millions, every year. We have single establishments which produce ten thousand pairs of shoes in a day. We make footwear of every description, from hobnailed boots for miners, which are heavy as lead, to slippers for young ladies as light as the slipper that Cinderella lost when she danced with the Prince. We have five hundred shoe factories working for children and babies, several hundred devoted to women's shoes only, and a still larger number making footwear for men. If all our factories were kept busy, we could produce more than five hundred million pairs of boots and shoes in one year, or enough to shoe one third of all the men, women, and children on earth, including the babies.

It used to take two of the old-time cobblers a day and a half, working steadily, to manufacture one pair of coarse boots; and the cost was four dollars. Now, by the aid of machinery and the division of labor, the time spent upon a similar pair is reduced to four minutes and the labor cost to thirty-five cents. In the first case the boots had to pass through eighty-three different operations, performed by the hands of the two cobblers. In the second they go through one hundred and twenty-two operations performed by various machines, aided by one hundred different men, each of whom does one thing over and over again.

Suppose we go back to the days of the colonies, and see

An old-time cobbler.

how the foot gear of our forefathers was made. Thomas Beard was the first shoemaker to come to Massachusetts. He arrived in the *Mayflower* in 1629, bringing a supply of hides with him. Others of his kind followed, and they soon began making boots and shoes of American leather. At that time it was common for the cobblers to journey about from one farm to another, staying at each house long enough to make the home-tanned skins into shoes for the family. It is said that the wooden lasts were sometimes whittled out to suit the biggest foot among the men, and that they were then pared down for the women and children according to the sizes needed.

By and by, as the country became settled, shoemaking shops sprang up in every city and village, and the cobbler

was an important member of every small town. He usually sat upon a low bench at one end of which were boxes for his knives, awls, and hammers, and also his pot of paste and blacking. He had a rasp to file off the pegs, a shoulder stick for setting the heel and sole; rubbers for finishing the bottoms; and tacks, pegs, and nails, as well as thread, wax, and buttons. In our colony days every child knew just how his own shoes were made; for all were manufactured by the local shoemakers, not far from the homes of those who wore them.

A little later on, shoes were manufactured in small factories; the leather being cut out, and sewed and pegged by hand. The industry began in Massachusetts, and especially in Lynn, about eight miles from Boston, a place which is now noted as one of the chief shoemaking centers of the world. For a long time only coarse shoes were made; and the best of our foot gear was still imported from England and France. Then skilled workmen came across the Atlantic. They taught our cobblers their art; and Lynn was soon producing shoes and boots equal to the best that had been brought in from Europe. The fame of its manufacture spread throughout the New World; and as the demand grew, other New England towns took up the business, and shoe factories became common.

Then, a little before our Civil War, there were shoemaking inventions. The sewing machine came into use, and this was followed by other machines, made by Americans, until now, nearly every process connected with this industry is aided by steam or electricity. Some of our factories have as many as two hundred kinds of

shoemaking machines. We now have, especially in and about Boston, great shops for manufacturing machines for shoe factories, and we export such machinery to many parts of the world.

At the same time a great shoemaking industry has sprung up in different parts of our country. This is especially so in New England, where there are several cities whose chief business it is to make shoes. One of these is Brockton, Massachusetts, which produces something like twenty million dollars' worth of foot gear every year, and next come Lynn and Haverhill in the same State. Philadelphia is noted for its fine shoes of glazed kid; and in the Central States, Cincinnati and St. Louis have enormous shoe factories. Boston, New York, and Chicago are our chief wholesale markets for all kinds of footwear.

Suppose we visit one of the New England factories. That we select is situated in Massachusetts, and is one of the largest in the United States. Its huge brick buildings cover several acres; and it employs about three thousand hands, including women and children.

How busy it is! The smoke is pouring forth in black volumes from the tall stack, men are shoveling the coal into the fires under the boilers, and machines are humming away in the various rooms, making such a din that we can hardly hear our guides talk. The smell of the newly tanned leather fills the air. We see the hides brought in from the cars in boxes, bundles, and bales. There are cowhides from many parts of the world, sheepskins from our country, goatskins from South America and Africa, and also vast quantities of pegs, buttons, clasps, thread, shoe laces, and trimmings.

We follow the leather on into the factory, and watch the men sort it and prepare it for cutting. Every part of the shoe has its own special material, and each must be trimmed before it is used. The sole leather is divided into strips of just the right length; and these are rolled and shaved and then cut by dies into the shape of the sole.

Cutting room in a shoe factory.

The smaller pieces are used for heels, and all are sorted, and tied up in bundles.

While this is going on, the materials for the upper parts of the shoes are shaped in the rooms overhead. Here the leather is softer and finer. It is of calfskins, goatskins, or sheepskins, or perhaps of the skins of kangaroos, porpoises, and seals, according to the shoe and the place the leather is to have in it. Each part of the upper has its own cut and name. That over the toes and front of the foot is called the vamp, that on the instep and around the ankle the upper, and other parts are the tongues, eye stays, side

linings, facings, trimmings, and tops. Each of these is cut out separately, by machinery, by men who work rapidly; and at the end the various cuts are sorted and arranged in bundles, all the parts for each pair of uppers being tied together.

These pieces are sent to the sewing room, where they are properly fitted and sewed together. Each piece goes

Stitching room in a shoe factory.

through several machines, in order that it may be joined to some other part; and at the end all come out with the buttonholes and linings properly fixed.

The upper part of the shoe is now complete and ready to be joined to the soles. The insole, which is of soft leather, is first tacked to the lasts; the upper is stretched over the last and tacked to the insole, a steel shank is tacked on, the heavier bottom sole is attached and then the last is withdrawn, and the insoles an

uppers are sewed firmly together. The heels are made separately; they are trimmed and polished by machinery, and the nails are driven in at the rate of fifteen at one stroke.

All these processes seem wonderful to us. We see a boy fit the part of an upper into a machine, and then throw

Finishing heels in a shoe factory.

into it a handful of buttons. He drops them in as carelessly as we throw the grains of corn into a popper. He then turns the machine, and a moment later pulls out the upper with eleven buttons sewed on at just the right places. As we look, he tells us that his machine can sew on more than eight thousand buttons in a day.

Going on, we are shown how the shoes are finished, and

blacked, and polished. We see the labels put on, and finally watch the shoes as they are packed into boxes and marked for shipment to all parts of the world.

23. GLOVES

IF all the animals whose skins are used to cover our hands could be collected together, they would form a congress as queer as any described by "Uncle Remus." Brer Rabbit, Brer Fox, and Brer Wolf would be there, and also the deer, dog, and rat. The party would include tall kangaroos from Australia with their babies looking out of the pouches on the front of their bodies; sure-footed chamois from the Alps and the Carpathian Mountains; pet kids from France, who have been fed upon milk that their skins may be thin; and the very young calves which furnish the rare gloves made at Limerick in Ireland, which are so fine that one can be inclosed in a walnut shell. There would be thousands of sheep and lambs from different parts of our country, and goats and kids from South America, Europe, and the high dry lands of Asia and Africa. There would be reindeer from the shores of the Arctic Ocean, and even walrus and seal.

Gloves are made of various kinds of leathers, and the skins used for the purpose come from all over the world. In Europe the skins of many millions of kids are employed in making the finest dress gloves. As the time for killing the kids approaches, the buyers appear and arrange for the skins to be sent to Naples, Leipzig, or Frankfurt, which are the chief markets for this kind of merchandise.

Most of our gloves are from the skins of calves, goats, sheep, and lambs, cured in a different way from those used for our shoes. The kid gloves are largely of lambskins, and those known to the trade as doeskin, buckskin, and dogskin are from the hides of deer and dogs and also of sheep and calves. Our chamois gloves are made of sheepskins tanned by oil dressing. When our country was settling, there were deer everywhere, and they furnished most of the gloves for coarse wear. Later on calfskins and sheepskins were employed. Heavy working gloves are made of horsehide.

We can easily learn about our glove industry by going to the regions where such wear is produced. There are certain parts of the United States where more gloves are made than anywhere else, and there is one little district, in Fulton County, New York, where the greater part of all the gloves we use are manufactured. One reason for this is that glove making, as a business, was first started there. During our colonial days most of our gloves were imported; but, shortly before our Declara-
tion of Inde ... ce was signed, among the pioneers who
settled in ... County were some glove makers from
Scotland ... brought with them over the ocean,
the patte ... eedles and thread required for glove
king. ... these Scotchmen began to
e gl ... he farmers about. They
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t w ... after Thomas Jefferson
cam ... the gloves were sold out-
le t ... e made. Then Talmage
lw ... town, took a bag of gloves

with him to Albany, when he went there on horseback to buy goods. He found no trouble in selling them and upon his return started a little factory to make gloves for export. He bought his leather in quantities; and then got the farmers' daughters to come into his shop and cut out the gloves, which were then carried to their homes to be sewed. Fulton County soon became famous for such wear; and after 1825, when Elisha Johnson of Gloversville took a load of gloves in a lumber wagon to Boston and sold them, these people began to manufacture for the whole United States.

At first, as we have seen, only the cutting was done at the factory, the gloves being sewed by the country people who came from miles around and took the cut skins to their homes in bags. A small skein of silk was put in with each set of skins, to be used in working a vine on the back of the glove. When a glove was completed, it was laid between folded pasteboards; and the maker sat on it to press it, while sewing the next glove. After a time dies were constructed to cut out the gloves; and then machinery to sew them; and now a great part of our glove making is performed by machines of various kinds, worked by steam power.

Suppose we cross into New York to visit the glove makers. We say good-by to our friends of the New England shoe factories, and then go on the train from Boston to Albany. We then leave the Hudson River, and traveling due west, soon find ourselves in Gloversville, where our glove-making industry started and where there are many glove factories. We take a carriage and drive through the country about, observing that

many women and girls are still working upon gloves at their homes. We are told that it requires only a week or so for one to learn how to do the rough sewing; and that the price for making common gloves ranges from twenty cents to one dollar per dozen. Many gloves are still cut out at the factories and carried by the wagon load over the country, some being left at each farm. The factories furnish the thread, buttons, and the other materials; and the prices for sewing are such that those who work thus at their homes do well if they make fifteen or twenty dollars a month.

Let us visit one of the factories. It is there that the finest gloves of all kinds are made, only the cheaper grades being sent out to the farms. As the skins come in, they are either raw or half cured, and they must be tawed much after the processes we saw when we investigated the

Fitting room in a glove factory.

leather industry. They are given baths of alum and salt, and are then treated with the yolks of eggs to make them soft and pliable. Some of the skins must be dyed, and all are sorted for the various kinds of gloves. For the finer sorts, the skins are polished with flannel pads, the white ones being rubbed again and again.

The skins must also be shaved, dressed, and stretched, before they are ready to be cut into the oblong or square pieces of certain lengths required for the various sizes of gloves and mittens. For the coarser ware this is done by machinery, two or three skins are laid at one time under a cutter, and the square pieces chopped out. For the finer gloves the pieces are cut and stitched by hand.

In another room we see men shaping these squares into the form of the hand. The machine which does this work is somewhat like an old-fashioned printing press. The man takes six pieces of skin and lays them in a square box in the bottom of which is a shiny steel hand. The skins just fit in the box, and they lie upon the hand. The cover of the press is now fitted on, the machinery moves, and the leather is pressed down upon the hand so tightly, that when it is taken out, it is cut in the shape of six gloves as beautifully as could be done by the most careful workman with scissors. The only things wanting are the thumbs and the little strips which join the sides of the fingers. These also are cut out by machinery; and the pieces are then ready to be sent to the sewers. They are given over to girls, who join them together on sewing machines.

There are many people who work on each glove. The makers sew in the fingers and insert the thumbs, an

others stitch the hems around the wrists and the ornamental lines on the backs. Some women form the button-holes, and sew on the buttons; while others join the pieces between the fingers and sew the long seams which go around the fingers and sides.

After the glove is sewed, it is stretched over a metal hand and treated with steam to give it the right shape

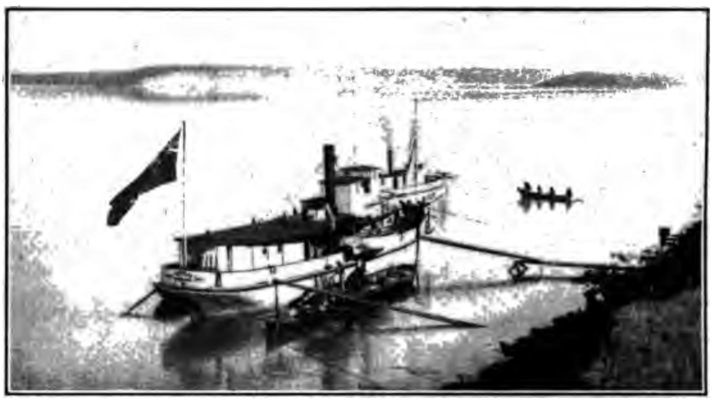
Stitching room in a glove factory.

and finish. It is then ready for inspection and sorting, and to be packed up for the market.

We make all together thirty-five or forty million pairs of gloves every year. The industry is carried on in hundreds of factories, giving employment to many thousand people. It is important not only here in Johnstown and Gloversville, but in many other parts of our country. The chief States engaged in the industry are New York, California, Illinois, and Wisconsin, with New York far in the lead.

24. FURS

IT is on the Mackenzie River, in the far northern part of our continent, that we begin our travels this morning. We left the glove-making regions some weeks ago, going northward through New York to Buffalo, and on to Toronto, in Canada. From there we traveled by railroad to the city of Edmonton, not far from the Rocky Mountains, in the Province of Alberta. Thence we made our way



". . . one of the little steamers of the Hudson Bay Company."

northward to the Athabasca River, and, on through Athabasca Lake and the Great Slave Lake, into this mighty stream which will take us down to the Arctic Ocean. We are in one of the little steamers of the Hudson Bay Company, moving slowly along through the wilds, from trading post to trading post. At each port we leave goods to be sold to the hunters and trappers, and take on great bales of furs to carry back home.

How delightful the far North is in the summer! The trees are in leaf, there are flowers everywhere, and the air is pure, fresh, and cool. By and by all will be covered with ice and snow. This river will be frozen, and the only means of getting about will be on foot or on sledges pulled by long teams of dogs. If we stayed until then, we should need fur clothing throughout, and might sleep in fur bags at night.

Just now the weather is even more pleasant than our summers at home, and we enjoy the fresh green of the forest. At every stop of the steamer we see copper-skinned Indians who have come in to trade. We observe their canoes on the streams and on the Mackenzie, and now and then pass their huts and tents on the banks of the river. The Indian boys shout out a welcome, and the little papooses, tied to the backs of their mothers, look forth from their skin bags with wondering eyes. We are in a country from which the greater part of our fur clothing comes, surrounded by the homes of our fur-bearing animals and with the agents of a company which has long been famous for carrying on the most of the fur trade of the world.

Until the time of Charles II of England, when the Hudson Bay Company was formed by a party of English noblemen to send out ships and to gather furs from the northern part of our continent, most of the furs used by man came from the colder parts of Europe and Asia. The Greeks got their choicest furs from southern Europe and Russia, and Herodotus tells us that the natives about the Caspian Sea wore sealskins. The Romans bought furs from Africa, and from the barbarians north of the

Alps. Cæsar speaks of the Germans as clad in reindeer hides, and it is related that the tyrant Nero sat upon an ivory throne which rested on the skin of a lion, whose stuffed head formed his footstool. During the Middle Ages and for a long time thereafter, the Baltic Sea ports were great fur-trading centers; and there were also big fur markets at Amsterdam, Leipzig, Vienna, and Paris. There have been fur fairs at Leipzig every year for more than five centuries; and another fair is held at Nizhni Novgorod, on the Volga River.

Great quantities of furs every year are sold at auction at St. Louis, but the world's chief fur market is London. From Siberia come furs of the sable, lynx, and ermine, trapped by hunters who travel through the forests for weeks at a time. They start with sleds loaded with provisions; and, as these are eaten, fill the bags, from which the food was taken, with skins. From Persia, and from the highlands of Tibet and Mongolia, are sent the skins of newly born lambs, which go by the name of Persian lamb furs; and from high up in the Andes comes the skin of the little chinchilla, whose fur is among the softest and most beautiful known. The chinchilla belongs to the family of rats, but in form and character, it is more nearly like the hare or rabbit. It is about nine inches long, with a tail of two inches; it has big black eyes, and a mustache twice as long as its head. It lives in holes in the rocks and thrives high up in the mountains. The variety which gives the best fur is of a blue-gray color. In South America also lives the coypu, an animal closely allied to the beaver; its fur, called nutria, we use largely in making fine hats. The coypu has its

burrows on the banks of the Plata, and it spends a great part of its time in the water.

Some of the best furs of all, however, are from our own continent. We supply many musk ox, seal, and sea otter skins; and also those of wolves, bears, and of lynx of different kinds. We have great quantities of fox skins, squirrel skins, raccoon skins, and skunk skins, as well as those of beavers, muskrats, badgers, and hares. Indeed, the fur trade of our continent is by far more important than that of any other of the world's grand divisions; and more of the furs, used as man's clothing, come from it than from anywhere else.

Trader and Indian bargaining for furs.

In the early days of our history, the most valuable furs were purchased of the Indians in exchange for glass beads and buttons; and when the Hudson Bay Company first came into the New World, it is said that

the traders sometimes stood a gun upright on the ground and had the Indians pile up beaver skins to the top as the price of the gun. When the settlement, on the island of Manhattan, was still known as New Amsterdam, having not yet received its name of New York, beaver skins were used as money in place of gold and silver. It was a New York man, John Jacob Astor, who early in the last century started the American Fur Company which operated throughout our great Northwest and British Columbia, competing with the Hudson Bay Company. After our purchase of Alaska we did an immense business in the skins of the seals from the islands off the shores of that territory, and we have many choice furs from Alaska to-day.

The Hudson Bay Company has divided up the wilds of British America into hunting districts with one or more traders in each; and many Indians, Eskimos, and half-breeds make their living by hunting and trapping to sell the furs to its traders. Of late years other companies also have established trading posts; and now the northern part of the continent is dotted with these little log settlements to which every year merchandise is sent and bales of furs are taken away. There are trading stations all along the Arctic Ocean, and at the mouth of the Mackenzie River, where we are going. The Hudson Bay Company has its posts in Labrador, in northern Quebec, and about Hudson Bay. For more than two hundred years this company has annually sent one or more ships across the Atlantic Ocean and through Hudson Strait, into that great inland sea, to carry goods to the Indians, and to bring back to London their cargoes of furs. The company has a central store in the city of Winnipeg, and large branch

stores at Prince Albert and Edmonton, and in other parts of the West. There is also a French trading firm, Revillon Frères, which has trading posts in all the fur-

Fort Good Hope, a trading station on the Mackenzie River.

bearing parts of the world. It buys many furs from these regions, and ships them to New York and Europe.

A great deal of the fur hunting is done in the winter. The animals are then trapped, and their skins are salted

A sled load of skins.

and dried. They are carried to the posts in bundles on the backs of the trappers, or they may be taken down the streams in canoes or across country on sleds hauled by

dogs. The time for bringing them into the posts is usually October and March, when the Indians take back their supplies of goods for the rest of the year. In such trading no money passes, but each fur is estimated as worth so many "skins," and is traded for goods in proportion to its value. For a long time the standard skin was the beaver, every fur being equal to so many beavers; but now the unit is a skin worth about fifty cents or less, according to the location of the trading post and the cost of getting the goods to it. When a pack of furs is brought in, it is carefully examined, and the value of each skin is decided upon by the hunter and the official in charge. At the same time the official gives the hunter as many pieces of wood, each representing the fixed unit of value, as the skin in question is worth. When all the skins have been gone over, the Indian takes the wooden checks he has received into the storeroom and uses them, just as we use money, to buy such guns, blankets, canned goods, tea, tobacco, and other things, as he needs. In the regions farther south, the skin values are sometimes represented by goose quills, bits of shells, or disks of lead stamped with the Hudson Bay Company seal and bearing certain figures, such as 1, 2, ½, and ¼, each representing so much value in beaver.

Many of the white traders go into the wilds as boys, and some spend their lives there. They learn the Indian language, and sometimes marry the squaws and have families. They are very anxious to secure fine furs, and will often travel out to the Indian camps, carrying food, blankets, clothes, trinkets, and other merchandise with them. At such times, the white man upon arriving does

not mention trading to his Indian friends. He pretends that he has come merely to make a social call, and inquires after the health of the tribe. He also asks every brave he meets how his wife and family are, and spends his first day in smoking with the men. Often a night passes before business is mentioned. On the day following, he may ask one of the Indians if his luck has been good, and if the Indian says yes, it is a sign that he has furs and is willing to trade. If he says no, the white man goes on smoking. After a while the Indian may become friendly, and pulling a mink or some other kind of fur from inside his coat, may ask the trader what he will give for it. If the price is a good one, the Indian will sell; but if not, no more skins will be brought forth, and the business with him and probably with the whole tribe is ended for that day, at least. The Indians are wary; they know all about the different skins, and just how much each is worth.

Through our talk with the traders, we learn that the skins vary greatly in price. One of a silver fox, only three feet in length and not more than eighteen inches wide, may be worth a thousand dollars and upwards, and that of a sea otter seven hundred dollars or more. The snowy-white fur of the ermine is costly, and Russian sables are so valuable that a coat lined with them has sold for thirty thousand dollars. On the other hand, the skins of squirrels, opossums, and deer may be valued in cents, and those of the beaver and bear are still comparatively cheap. We all know that sealskins are worth a great deal; as are also some other furs, of which we shall learn more as we go on with our travels.

After the furs are bought, they are put up in bales and

". . . skins vary greatly in price."

shipped from the posts to the seaports. Some of those that go to New York are sold and cured there; but most of the product, not only of North America, but also of Asia and Europe, as we have already seen, finds its way to London, where fur dealers from everywhere go to buy their supplies for the factories.

25. SOME VALUABLE FUR-BEARING ANIMALS

TRAVELING on northward on our Hudson Bay Company steamer, we now and then leave the boats and go off into the wilds with the trappers, learning much

about how the various animals are caught and killed, and how their skins are taken into the posts. As we near the mouth of the Mackenzie, we say good-by to our ship and join a party of hunters who are going across country to the head waters of the Yukon River, down which we shall sail into Alaska, and on through to the mouth of the Yukon in Bering Sea. The first part of this journey

A beaver home.

is made upon foot, our provisions and blankets being packed by Eskimos who carry great loads on their backs.

All our way is through the haunts of wild animals. We now and then see deer, bear, and wolves, and sometimes stop and camp awhile to trap beavers. We can tell where the beaver homes are by the dams which they build across the creeks. They live in burrows or holes on the banks of such streams, having an entrance so far under the water that they can swim in and out, no matter if the stream should become very low. They make

their doors to their underground houses below the deepest point at which the ice freezes in winter.

In constructing their dams, the beavers are their own wood choppers, carpenters, and masons. They cut down the trees with their teeth and drag them into place. They lay them side by side so that they form a barrier from one bank of the stream to the other, and then gather mud, stones, roots, and bark, and so place them in and about the tree trunks that they form a solid dam which holds back the water.

Beavers are sociable animals. They usually live in colonies, and sometimes have little underground towns in the earthen banks above their dams. Each family has its own burrow, the floor and the walls of which are made smooth by gnawing and rubbing. They feed largely on the bark of certain trees, which they bite off during the summer and store away in their homes for their winter provisions. They are also fond of roots, green vegetables, berries, and leaves.

The coat of the beaver is soft, dense, and warm. The animal is about two feet in length from nose to tail, and it furnishes quite a large skin. The fur consists of two kinds: an outer coat, made up of the longer hairs which are coarse, smooth, and glossy, and an under coat of fine short hairs which are soft and silky. The fur is used for making hats as well as for muffs, collars, coats, cloaks, and other wearing apparel.

In the summer, beavers are caught by means of steel traps, set at spots near their dams; and the hunters sometimes shoot at them from concealed places hard by. In the winter, the Eskimos find where their burrows are and

dig a hole, through which they can run a slender stick into the burrow, with one end of the stick projecting. The earth is then replaced, and spear in hand, the hunter waits until the beaver comes home. He knows when this is by the motion of the stick, which the animal tries to pull in or to bite off. He thereby locates the beaver, and is able to drive a spear through the ground into its house, thus killing it.

Beaver.

Farther down the Yukon, in midwinter when the waters are frozen, some of the beavers' lakes become so drained that there is only a sheet of ice over the almost empty bed of the stream. The hunters cut a hole through the ice, and if they find beaver tracks in the mud below, they take stout clubs and crawl under to search for the animals. They seek out their homes, and drive them forth and kill them.

Away off in Australia, on the other side of the globe, there is a little animal somewhat like the beaver, called the platypus, which lives in holes in the banks of the streams. It has one entrance to its home from the land, and another from under the water. The platypus can swim like the beaver, and it can also crawl upon land. It is odd, in that it is an animal which lays eggs, and also because it has a bill and feet somewhat like a duck. It is much smaller than the beaver. Its hair is thick, soft, and silky, and is often used for furs of various kinds.

Is it not strange that many of the animals which give

us our most beautiful furs spend a great part of their lives in the water? This is true of the mink and sea otter; and also the seals, which we shall visit at their island homes farther on in our travels. The mink is found in abundance in all parts of British America, and especially about Hudson Bay and in Labrador. Some are caught here in Alaska, and many come from different parts of the United States. This little animal is from fifteen to eighteen inches long. It is a sort of weasel, distinguished from the other varieties of that kind by its love for the water. Its home is a burrow near some stream, and it lives largely on fish, frogs, and even shell animals. The fur is usually brown, and the darker it is, the more costly. Mink are caught in great numbers, and hundreds of thousands of their skins are annually sent to London for sale.

Mink.

Sea otter.

The sea otter, which also lives in the water, is far more

valuable than either the mink or beaver. Its fur is so prized that the hunter can sell a single raw skin for one or two hundred dollars, and a fine overcoat, lined with such skins, sometimes brings as much as two thousand dollars. The value of the sea otter shipped from Alaska surpasses that of any other kind of furs, with the exception of sealskins. During the time that the Russians owned that country, it is estimated that more than a quarter of a million sea-otter skins were sold, and that they brought in over twenty-five million dollars. When we purchased Alaska of Russia, the price paid was a little more than seven million dollars. Since then we have caught in those waters more than one hundred thousand skins of the sea otter, and have sold them for almost half again as much as we paid for the whole territory. Our sales of sealskins from there have embraced several millions, and the money received from them alone, is almost seven times as much as we paid for the territory. When we think of the enormous wealth of Alaska, in gold, copper, and other minerals, as well as in fish and fur animals, its purchase seems to us one of the best bargains Uncle Sam ever made.

Returning to the sea otters, they have become so scarce that our government is now doing all it can to protect them. It prohibits the use of nets in capturing them, and will not permit the pups to be killed. The sea otters have their homes along our Alaska coast from Sitka to Bering Sea, and some are found upon the shores of British Columbia. They feed on crabs and certain fish. They have broad hind feet, much like the flippers of the seal, and they swim far from the land. They are caught

by hunters who build platforms some distance out in the sea and high above the water, and from them watch the shores. They use glasses in order that they may see the animals, and they shoot them as they swim from the sea to the land. The Indians also hunt them in canoes, going out and coming in through the surf. The sea otters, however, are now so scarce and so difficult to kill, that if one man gets four or five skins in a season, he does well.

If we would find the best sables, we must cross Bering Strait into Siberia, not far from the ocean. The sable belongs to the marten family; it is closely related to the pine marten or American sable, which, for two hundred and fifty years, has been one of our most valuable furs. The American marten, however, is by no means so fine as the Siberian sable. The latter fur is usually known as Russian sable, which is equal to and sometimes higher than the sealskin in value. These sables live in the woods of northern Siberia. They feed upon squirrels, mice, and birds, and even upon hares and grouse, trailing them with the nose like hounds. They are often caught in traps, in order that their skins may not be injured, as is sometimes the case in shooting or spearing them; and they are so carefully skinned that no portion of the fur is lost or damaged. The ordinary sable measures from a foot to eighteen inches, from its nose to its tail. The fur


Ermine.

is usually of a light brown ... on the back.

Another fur of great value ... kind of weasel, which is ... land, northern Russia, and ... this little animal has a coat of ... except on the tip of its tail, ... is so soft, white, and fine ... royal fur of some of the ... certain countries, in times past, all others were forbidden to use it. It can now be worn by any one who can afford it; and it is highly prized as a lining for ladies' cloaks and for making collars and muffs, as well as dress trimmings.

... fur of the ... best.

... il ... id ... are

the winter in these northern latitudes, it becomes snow-white and is most beautiful about Christmas.

The hunters follow the ermine by its tracks on the snow, and set traps across its path by bending down limbs and hanging nooses to them. As the ermine runs in, the limb springs back and the noose tightens about its throat, strangling it instantly. The hunters can tell the age of the ermine from its tracks. If the prints are like those of a baby's finger, close and small, the hunter knows that the animal is young and fine; and if the leaps are long, he knows that it must be a full-grown ermine, worth less and with hair too coarse to be damaged by his snare. For hunting the babies he has more delicate traps, and he uses great skill to secure them undamaged.

26. AMONG THE FUR SEALS

WE have returned from Siberia, have re-crossed Bering Strait, and are back again in United States waters. We have sailed to the southward through Bering Sea, and are now on our way to the Pribilof Islands, where the fur seals come by the thousands each summer to breed and raise their seal puppies.

The weather is stormy, and our ship rolls back and forth. The sky is filled with dark, low-hanging clouds. It rains most of the time, and we are often enveloped in mist. Now and then, the fog breaks, and we can see small volcanic islands rising out of the water. They are green near the shore; but, higher up, all is bleak and bare rocks, which

are finally lost in the clouds. There are many sea birds following our steamer; now we see a whale spout, and now pass a school of fish which jump high out of the water.

By and by we come to the Pribilof Islands. They are more dreary than any we have yet seen. They are of black lava; and black sand, made of the lava ground up by the ice and the waves, covers their shores. There are no trees; but now in the summer, the slopes of the hill are carpeted with green moss, and there is tall grass in the valleys. As we sail by the shore, we can see, with our glasses, many wild flowers. There are yellow poppies, blue forget-me-nots, dark-hued violets, and flowers of other colors, the names of which we do not know. We observe many black and brown animals crawling over the rocks, and are told they are seals.

Steaming by the island of St. Paul, we make our way on down past Otter Island, until we finally reach the Isle of St. George. Here there is a little village made of frame houses inhabited by Indians and a few whites. It is the village of St. George, the residence of the agents of the United States government, who are sent here to see that the fur seals are protected, and that only the right ones are killed.

We can see the seals, as our ship comes into the harbor. They are scattered over the rocks of a great part of the island; and the din from the rookeries greets our ears, as we land. It sounds like a barking of dogs, a bellowing of cattle, and a grunting of pigs, all mixed together. The rocks are black with the puppies. There are great bull seals higher up, lifting themselves on their flippers and roaring. There are cow seals mooing; and the waters are

alive with seals of all sizes swimming around, each making a noise of one kind or another. We stroll about to have a look at the animals before we go with the agent to his home for a dinner on shore.

What queer things they are! They seem half fish and half beast, and indeed they are a kind of sea bear. The

Seals on the beach.

large ones are the bulls, and the small ones the cows, while those little black roly-poly fellows are the pups. The bulls are of great size, some being six feet long and weighing seven or eight hundred pounds. The seals rear up their heads, as we approach; and we observe that their necks, shoulders, and chests form the most of their bodies. What odd-looking heads! The mouth and jaw are not

unlike those of a Newfoundland dog, save that the upper lip overhangs and has a white and gray mustache of long, stiff bristles.

They have beautiful eyes of a bluish hazel color, and seem full of good nature. The seal has flippers instead of feet, and those at its front look like a pair of blue-black

Bull seal and family.

hands, the arms being concealed under the skin. The hind flippers are longer. They are shaped not unlike a human foot, and are so made that the animals can gallop over the beach.

Observe the fur! The seal has two coats; an outer one of short, crisp, bristly hair, and beneath that another of thick down, as fine and soft as silk plush. The outer is of a pepper-and-salt color, and that beneath is golden

brown. The outer hair is taken off, and that remaining is dyed a dark brown before the fur is ready for use.

As we go on with our walk about the shore, we find seals everywhere. Some are piled on top of others, and many are sleeping so soundly that we can stroke their soft fur and not wake them. Now and then we stop to pull the tail of a puppy. It spits and sputters at us somewhat like a cat; and, as we let loose, it goes wabbling over the rocks, knocking its companions this way and that, not seeming to care for bumps or bruises. These young seals are as black as our boots. They are not bigger than dogs. The bulls and cows at this season are quite gentle, and we have no trouble in making our way about among them.

Finally we come to the house of the agent, where we spend several days. We go with him over the island, learning much about seals and seal hunting. We stroll from one rookery to another, studying the animals and their habits, and seeing how their skins are secured for this, the most beautiful of all furs.

We are told that there are two great families of seals, both of which live in the sea. One family, the Phocidæ (fo′sĭ-de), are sometimes called the hair seals. They supply seal leather and oil, and are very different from the fur seal, belonging to the Otariidæ (ot-a-rī′ĭ-de) family, which provides our fashionable furs. The animals look much the same, save that the Phocidæ have no visible ears and no woolly undercoat of fine fur.

The fur seals of commerce come from the cold parts of the world. Most of them are from these islands of Alaska; but some are found on the Commander Islands, belonging to Russia, in Bering Sea; on Robben Island off the coast

of South Africa not far from the Cape of Good Hope; in New Zealand, and also in Lobos Island at the mouth of the Plata. A few very fine ones come also from the South Shetland Islands in the Antarctic Ocean, south of Cape Horn. Within recent years, the most of our fur seals have come from the Pribilof Islands, where we now are. Since 1867, when we purchased Alaska from Russia, millions of the finest sealskins have been taken from here, and the taxes upon them have paid into the United States Treasury more money than the whole amount we paid for Alaska.

But why are the fur seals found more abundantly on these islands than anywhere else? And why have they come here for ages year after year? These questions are difficult to answer. None of us would choose the Pribilof Islands as a place for business or comfort. They are wrapped always in fogs, and even in summer, although the weather is not cold, it is damp and chilly. In the winter, everything is frozen solid; there are frequent snow storms, but the snow is soon blown off by the terrific winds of these far northern seas. It may be that the seals choose the islands as their summer homes, just because they are so bleak and so wrapped in fogs, and at the same time so far away from other islands that they consider themselves comparatively safe from their enemies.

At any rate, no one knows the day when these animals began coming to the Pribilof Islands. They spend their winters in the warmer seas, many going through the passes of the Aleutian Islands into the Pacific Ocean, and swimming about in latitudes as far south as Puget Sound and San Francisco. Others, chiefly the older males, re-

main in Bering Sea; and in the milder winters, some will even stay here on these islands. No matter how far the seals may go, they will come back the next year, and, beginning in May, populate the Pribilofs throughout the summer.

The old bulls arrive first, and fight fiercely among themselves for the best places. There is a great choice in the rookeries, and the strongest and fiercest of the animals take those near the shores. The bulls who are conquered have to take the back quarters, while the youngest and weakest of all are crowded off far to the rear in a place by themselves. The young males are called bachelors, and they must keep bachelor's hall, as it were, behind the rookeries occupied by the older bulls and the cows.

About a month after the bulls have come, the cow seals begin to swim in. This brings another fight among the bulls, each of which wants certain cows. It is settled finally by every old bull having about thirty cows which he keeps with himself in his own rookery. He will not allow them to wander, and the cow who attempts to go outside is caught up bodily by the bull and thrown back into the fold. The bulls are several times as large as the cows, and they make them obey.

It is not long after this that the seal puppies are born. They are dear little fellows, looking much like young dogs, and bleating like lambs. As soon as they are able to walk, they gather together in crowds and play with one another like the puppies they so much resemble. In a few weeks they are able to crawl down to the seashore into the pools, where they learn how to swim. It is amusing to watch them. They plunge about like porpoises,

and race with one another; they scratch their sides with their flippers, and turn somersaults in the water. As they grow stronger, they swim farther and farther out, and are soon able to go miles from their homes. The bachelors are now allowed to come down and play with the pups, and the young bulls and the little ones have great fun together.

As the pups grow older their fur changes from black to brown, and finally becomes of a pepper-and-salt color, bristly outside and soft and downy within.

Ready to skin the seals.

During our stay on the island the time for the annual killing arrives. For this purpose, the herds are driven to the "killing grounds," which are situated close to the villages. Here they are rested and cooled for a time; for if the seals are slaughtered while heated, the hair will come off in the skinning. It is only the bachelors who are killed, and the law provides that no females or pups

shall be taken. The furs are the thickest and finest upon seals which are three or four years of age.

The killing seems cruel. At a given signal the men knock the seals down with clubs, while the poor animals run hither and thither and huddle together in trying to get out of the way. The clubbers keep at them until they fall to the ground, when other men stab them in the breast with sharp knives. After a seal is killed, its skin is taken off as rapidly as possible. This work is done by boys and men. The boys first cut through the skin around the head in front of the ears; and then the men, who are skilled in the business, strip off the skin, including the ears and tail. The skins are now partially cured between layers of salt. Later on, they are done up in bundles and shipped off to London, where they are sold, to be dressed, dyed, and fitted for use.

The Pribilof Islands are the only breeding place for fur seals. For years, as the seals went to and from the islands they were slaughtered by British and Japanese hunters until they were threatened with extinction. Finally the United States came to an agreement with Great Britain and Japan for the protection of the seals; as a result, the number of these valuable animals began to increase again. In 1921 it was nearly 600,000.

27. HOW FURS ARE DRESSED AND DYED

WHEN the raw furs are sold in London, New York, or elsewhere, the skins are stiff and greasy and often have bits of dried flesh sticking to them. Some kinds,

such as the seal, must have the long hairs pulled out, and some are dyed before they are used. There are great fur-dressing establishments in London, Paris, Leipzig, Moscow, and Petrograd in Europe; and also in New York, Philadelphia, Chicago, and St. Paul in the United States, New York being our center for this industry. Our workmen have long excelled in the preparation of mink, otter, and beaver; and they now dress and dye seal equally well, although for a long time the finest of the sealskin preparation was done only in London. To-day the French, Russians, Germans, and Americans all dress and make furs for the world's markets. In Asia, the Chinese excel at the trade, their people having cured and worn furs for more than two thousand years. The Germans are especially noted for their factories in which furs are dressed and dyed, and they prepare many thousands of ermine, fox, and squirrel skins every year.

When the skins come to our factories, those of each kind are carefully sorted as to size and quality; and almost every variety has its own special treatment before it is finished. In most cases the first work is to take off the grease and bits of flesh left by the hunters. This is done by moistening the skins and scraping them. After this they are soaked over night in cold water, and then washed in warm, soapy water. Such furs as have over hairs are now placed, flesh side downward, on a flat hard-wood beam, and sprinkled with chalk. They are then rubbed and well worked, the long hairs being cut off or plucked out.

In unhairing sealskins the plucking must be carefully done. Each skin, after washing, is stretched over the rim of an iron hoop and left there till dry. It is then soaked

in cold water for two or three days and dried again. It is now doubled, and warmed and scratched to loosen the hairs, and then placed on a beam with the fur side up. Now the picker pulls out the long hairs, grasping each between a dull knife and his thumb, keeping the skin moist and warm all the time he is working. Great care must be taken not

Beaming and plucking beaver skins.

to pull out the fine under fur, as that would leave bare spots on the skin. The roots of the hairs go much deeper into the hide than those of the fur; and sometimes the back is shaved carefully down and the hairs pulled out by the roots. The shorter hairs are often cut out with small shears, but in every way the work is difficult and slow, and it takes a long time to unhair one skin.

After this process, the sealskins are stretched again, and nailed on boards to dry. They are now dampened with salt water, and shaved off with a knife to a thin even surface, and are then ready to be softened or leathered.

The leathering process is much the same for all the finer qualities of furs. The skins, having been cleaned, fleshed, and plucked, are smeared over with butter or some other animal grease and laid down in tubs. Then men get into these tubs with their bare feet, and tramp up and down upon the greasy skins, treading and twisting them about until the grease has soaked in, and they are as soft as a glove. In some factories this work is performed by machinery.

The skins are now cleaned by sprinkling them with sawdust and tramping them. The dust takes up the grease,

". . . the furs are then whirled about in drums."

and the furs are then whirled about in drums so fast that the dust flies out and leaves them clean, soft, and fluffy. The fur is next combed with a steel comb to straighten the fine hair and remove any snarls; and it is then ready to be dyed and cut and sewed for coats, collars, muffs, or other fur clothing.

Many fine furs are not dyed, although our best sealskins are always so treated. The fur of the sea otter is neither plucked nor colored, and the brown sea otter, speckled with silver-tipped over-hairs, is especially valuable. No one would think of coloring the ermine, which is all as white as snow excepting the jet-black tip of the tail; and the natural dark brown fur of the mink is most beautiful.

Sealskins, however, will take on such a beautiful velvety brown, that dyeing them has become one of the finest arts of the furrier. In this process the skin is soaked in a solution of lime, to make the furs take the dyes better. The delicate colors are then brushed on coat by coat until just the right shade is secured. The fur is now treated with sawdust to take out the superfluous dye, and when the sawdust has been blown out, it is ready for use. The difficulties involved in securing the sealskins and in carrying them from the far-away wilds to the markets, as well as those of dressing them, are so many that we do not wonder that they bring a high price.

The skins are not yet ready for wear. They are no nearer clothing than was the raw leather at the shoe shops fresh from the tanneries, or that of the cured skins at the glove factories before cutting and sewing.

The furs have yet to be made into shape for man's use, and this work must be done by skilled hands. The cut-

ting of fine skins is like cutting money; for they are so valuable that one might cover them with five-dollar bills and yet not reach their cost. Each skin must be cut in its own way, and some garments will be made of hundreds of pieces, so joined together that they seem as one. The sable or mink is slashed into strips and narrow pieces of different shapes. These are matched in color and are so sewed together that there may be one thousand different bits in a large cloak. Some coats are formed of the skins of squirrel heads and some of the furry backs, breasts, or necks of other small animals. Even the coarsest furs are carefully selected and joined.

In manufacturing furs the heads or tails of the animals are sometimes left on, by way of ornament, as we often see in our muffs and collars; and great art is displayed in making each garment as odd and as beautiful as possible. Almost all such clothing is lined with satin, silk, or fine woolen goods; and furs themselves are sometimes used as linings for costly clothing. The commoner furs, such as the muskrat, skunk, opossum, and squirrel, are more cheaply made.

28. HATS

LET us take off our hats and ask them to tell us their stories. If they could speak, they might give us adventures quite as varied as those we have had in the other departments of this great world of clothing. That felt hat, belonging to Johnnie, was once the fur of a rabbit which ran wild with the kangaroos in far-off Australia;

that worn by Harry may have been on the back of a beaver, which once lived near a dam on a Hudson Bay stream; and the stiff derby hat Tommy is wearing has in it nutria fur from the coypu, a big water rat whose home was a burrow on the banks of the Plata. Many of the hats worn by the girls of our party are made by the felting together of the wool or fur of various animals, and it has taken thousands of silkworms from far-off China to furnish the ribbons upon them. Jennie's red tam-o'-shanter may have once been on the back of a sheep which possibly is still bleating and baaing on our Rocky Mountain plateau, and that fuzzy broad-brim that sits so lightly on Sarah Jane's head was made from the wool of a camel, which, ridden by an Arab, traveled over the sands of the Desert of Sahara. If the straw hats could speak, we might learn from them of the Japanese and Chinese by whom the straw braid was made; or of the bright skies of Florence and Leghorn in the Italian peninsula where such hats are woven. The finest of all straw hats might give us pictures of life under the Andes, and tell how it was shaped by the Indians of Ecuador, being kept moist that the straw might be soft in the process. In fact, almost every hat could tell us many new things; and from all we should find that the making of head gear is one of the chief branches of commerce and industry in the great world we are exploring.

No one knows just when man began to wear hats; but it was probably before the beginning of history. From the Bible, in the third chapter of Daniel, we learn that when Shadrach, Meshach, and Abednego were thrown into the fiery furnace, they had on "their coats, their

hosen, and their hats." The pictures on the tombs of the Nile Valley show us that the ancient Egyptians wore hoods. In old Greece most of the men went bareheaded, except when off traveling, and then they wore caps. The ancient Romans used no head coverings whatever, although the toga was so made that it could be pulled up to cover the head like a hood. A little later, hats became one of the symbols of freedom; and when Nero died, the citizens paraded the Roman streets wearing hats to show they had escaped from the chains of the tyrant.

". . . great bonnets of silk and velvet."

During parts of the Middle Ages, the noble women had great bonnets of silk and velvet adorned with peacock feathers, and those of the lower classes wore hoods. At that time the men sometimes wore bonnets, and the poet Chaucer, who lived in the fifteenth century, mentioned this in describing one of his characters: —

> "His stature was not very tall.
> Lean he was. His legs were small,
> Hosed with a stocken red.
> A buttoned bonnet on his head."

We know that beaver hats were worn during that period; for Chaucer describes a merchant as wearing one from Flanders; and Shakespeare a little later writes in one of his plays: —

> "He brushes his hat o' mornings,"

Puritans.

which meant that the man wore a hat which needed brushing, and most probably a beaver.

Some years after that, the Puritans adopted their high head gear made of felt unblocked, and then came the stiff, broad brim of the Quaker, of whom Thomas Hood writes: —

"The Quaker loves an ample brim,
A hat that bows to no salaam;
And dear the beaver is to him
As if it never made a dam."

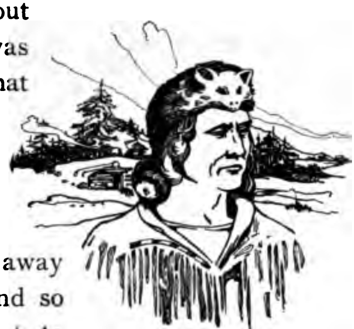
". . . the old three-cornered hat."

In colonial days our head gear was of different shapes, including the three-cornered hat adopted as a part of the uniform of the soldiers of the Revolution. That hat lasted awhile, and then passed away and became an oddity. We all remember how Oliver Wendell Holmes speaks of it on the quaint old man in his poem entitled "The Last Leaf." He says: —

"I know it is a sin
For me to sit and grin
At him here;
But the old three-cornered hat
And the breeches and all that
Are so queer."

During those early times our pioneers, who fought the

Indians, wore caps of coonskin and deerskin. Daniel Boone had a cap of that kind; and so, I dare say, had Davy Crockett. In the same period the people of the towns were particular about their head gear; and it was very early in our history that we began to manufacture hats for the market, both home and abroad. We were making much of our head gear before we broke away from the mother country, and so many of our hats were sent to England that the hatters there asked Parliament to forbid their importation. In 1810 the United States made almost a half million hats, of which forty-five thousand were manufactured in Pennsylvania; and in 1840, we made hats and caps to the value of more than eight million dollars.



"Daniel Boone had a cap of that kind."

We have now a large number of factories, producing hats of felted wool, and so many which make hats of fur, that they alone employ more than twenty-five thousand workmen and annually turn out a product worth millions of dollars. By and by we shall visit one of them, and shall see just how hats are made.

Before doing so, however, we desire to take a flying trip over the world, and to glance at the queer hats and caps of some other nations. We shall start in with the Koreans, the yellow-skinned, almond-eyed people on the little peninsula lying between the Yellow Sea and that of Japan on the east coast of Asia. The Korean men dress in long

gowns of bright colors and wear hats of many quaint kinds. Their hats are about the most important part of their clothing, and each hat has its own meaning. Those of the gentlemen are of black horsehair, so beautifully woven that one of the best costs over ten dollars. They have also caps of horsehair for use when indoors. They carry about great horns or cones of oiled paper, which fold up like a fan, and cover their fine hats when it rains.


Korean mourning hat.

The commoner Koreans, such as the bullock drivers and porters, wear hats of straw, some of which are as big as a small parasol. A man, when in mourning for a father or a mother, always wears for three years a somewhat similar hat, the hat being so shaped that it comes far down over his face and half hides his shoulders. The mourner also veils his features by a strip of gray linen which he holds up to shut out the gaze of the world and to show he is shrouded in grief.

Crossing the Yellow Sea, we find China a land of strange hats and other head gear. In the southern part of that country the peasants, both men and women, wear bamboo splints woven together into hats as big as the bowls which our mothers use to mix dough in. They are tied on with strings, and are worn when out working. Our Filipino farmers wear hats of somewhat the same nature, as do also the working people of Japan, Sumatra, and Java. The better-class Chinese men wear skull caps of

silk or satin beautifully made, with a bright-colored button of silk, coral, or crystal right on the crown. The material of the button and its color often indicate the rank of the wearer, as does also a feather which is fastened to the crown by the button, and sticks out behind. The caps are of different shapes. In recent years, since the Chinese began to cut off their queues, many hats like ours are worn.

Chinese skull cap.

Going down through Asia to India, we find many varieties of head gear. The Burmese wrap bright-colored silk or cotton handkerchiefs around their heads; and many of the East Indians wear skull caps, embroidered with silver and gold. In Ceylon some classes of men wear great hats of cloth and straw, while others go bareheaded, save for a comb which half surrounds the crown, much like those which our little girls wear. The Parsees of Bombay have small caps without rims, which fit close to the head; and they have also hats which look for all the world like inverted coal scuttles, extending high above the foreheads.

Turban.

We find many East Indians wearing the turban, which is the head gear of most Mohammedan peoples. This consists of a long cloth,

which is wrapped in a great roll around the head, and sometimes about a skull cap on the head. The turban may be white, red, yellow, black, green, or of some other color. If it is green, it is supposed to denote that the man who wears it has either made a pilgrimage to Mecca where Mohammed was born, or that he is one of the descendants of the family of the prophet. It is said that Mohammed wore green, and that this was his favorite color.

Another common head gear of the Mohammedan countries is the felt cap known as the fez or tarboosh. This rises five, six, and sometimes seven or eight inches above the head. It is without a brim, and has a blue or black silk tassel on top. Both it and the turban are kept on in house and out, and this is the custom even in the mosques or Mohammedan churches.

There are many countries where caps are almost universally worn by both men and boys. This is so in eastern Europe and especially in Russia. There the soldiers wear caps; the priests have tall, black, stovepipelike caps, with veils hanging to them, and the droshky drivers wear stiff caps of wool. The Tartars along the Volga have fur caps, and a common cap everywhere is one of sheepskin with the wool on. In Roumania and Bulgaria, they have such head gear of fur and lambskin; and in Greece both men and women use a soft silken red cap

Russian officer's cap.

with a tassel, which falls down on the shoulder; it is not unlike the stocking caps, which our children wear.

In northern Russia, fur caps are commonly worn during the winter, and the Laplanders, who live along the Arctic Ocean, wear tall caps made of fur or wool. All cold lands require warm head gear of one kind or another. In northern Siberia along the Arctic Ocean, both men and women have fur hoods which cover their ears and all the head excepting the face, and similar head gear is worn by the Eskimos of Alaska, British America, and Greenland.

In all the countries of the world where the people have the same civilization that we have, they are now dressing in much the same way. The odd costumes of the past, which were once common to many countries, are changing; and the same head gear is now used almost everywhere. The people of South America wear caps and hats much like ours. This is true of the inhabitants of Australia, of South Africa, and of most of the countries of Europe; so that about the same head gear is bought and sold throughout the civilized world. Therefore the hats and caps that we use can be manufactured for export to other countries, and those made elsewhere can be shipped here for sale.

29. IN A HAT FACTORY. HOW FELT HATS ARE MADE

IN our travels through the weaving mills, we saw many different fibers spun and woven together into goods of one kind or another. We are now to see another kind of cloth making without thread, warp, or woof. This is

possible only with certain animal fibers; and more especially fur and wool. We remember that the wool, as we saw it under the microscope, was covered with tiny scales like those of a fish; and that in spinning the scales of the several fibers interlocked, and thus enabled the thread to be made. Similar projections are found on the hair of certain animals. They are like barbs, all sloping towards the tips of the hairs. This is so with the fur of the beaver, coypu, rabbit, muskrat, raccoon, and cat.

It is this roughness, caused by the scales and barbs, that enables us to make felt. By mixing, pounding, and pressing the fibers together, the wool or fur can be so treated that the fibers will firmly interlock and form a compact sheet of cloth. We may do this ourselves by taking a bunch of damp wool in the hand and kneading it, and then rolling it out upon a board. After a time one finds that the wool has become a flat cake, and by long practice, perhaps, one might finally reduce it to felt. The first felt maker laid the wet fibers on a sheet of rawhide, and pounded them into one mass with a mallet. Later, cloth or wool felt was made by machinery, and now there are large mills devoted to this manufacture. The wool is first carded and then blown by fans into webs. After that it is run through rollers and other machines, so that it comes out in the felt cloth of which table covers, blankets, linings for rugs, coarse overcoats, winter jackets, riding habits, and long winter cloaks are made.

It is on the same principle, but by quite different processes, that we manufacture hats of fur felt and wool felt. The felt hats are most interesting. The fur must be first cut from the skins and prepared for the hatters. This is

often done in separate establishments both in this country and Europe. The finest hat fur comes from Germany, being cut from skins, sent there from various places. Our hatters import much of their fur ready cut; but we have also large hat factories which buy the skins with the fur on, and cut and prepare it for their own use. It is such a factory that we shall visit, following the soft down from the backs of the coypu, beaver, and rabbit, to its final place in the felt hats of commerce. Is it not strange that we must rob these animals of their hair, to cover our hair?

Here we are in the factory, surrounded by skins. They have been brought in bales from many parts of the world. There are hare skins from England and France; rabbit skins from Australia; and nutria from far-off Argentina. There are but few beavers, and the men tell us that that fur is becoming so costly that it is used less and less every year. We see coney skins, which have been shipped here from Scotland, and also the skins of muskrats, raccoons, and rabbits from Canada and the United States.

The men pick up several skins and lay them before us. They show us that the fur of each consists of a fine soft downy coat with coarse long over-hairs running through it, and that the fur is matted and filled with dust. They tell us it must be well cleaned, and the over-hairs taken out, before it will be ready for use.

This is done by a process called "carroting." This consists of treating the hair with certain chemicals that turn it as yellow as a carrot, from which vegetable the word *carroting* probably came. The mixture is composed of quicksilver, nitric acid, and water, of which the first two are so dangerous to handle that the workmen use

rubber gloves in brushing the solution into the hair. When the fur is thoroughly wet, the skins are hung up and dried; they are then brushed by machinery until every hair stands up as fluffy and clean as though it were on a newly hatched chick.

The long coarse over-hairs are now taken out by means of electricity. On a cold day, when there is much electricity in the air, you may have noticed how the fur of a cat stands straight up, and that when you rub it briskly an electric spark sometimes flies forth. It is after somewhat the same principle that the electrical machine in our factory raises up the hairs on the skins so that the machines can clutch the longer ones and tear them out from the soft fur beneath. After this the hairs are further removed by a blowing process, and the fur is ready for shearing.

The skins are now taken to the cutting department and passed through machinery in which many shears, rapidly revolving, cut the fur away much as we saw the sheep-shearing machines cutting off wool. The skins are left as clean as though shaved by a barber, the fur coming away so smoothly that it keeps its shape, and, as it is carried off on a great belt or apron, looks just like a skin with the fur on. When we examine it, however, we observe that it is nothing but fur, and that the hide itself has been cut up by machinery into such small pieces that it is of no value whatever, except to be made into glue.

As the fur comes forth, it is sorted by the workmen, each of whom takes out that of some part of the skin and lays it in a place by itself. The different kinds are then mixed in certain proportions, according to the

quality of the hat to be made. After this the material is passed through a mixer, and then goes on through a series of rollers and cylinders studded with wires. The cylinders are called pickers; they fly around at the rate of eighteen hundred times every minute, and when the fur comes from them, it is fairly well mixed. It must now be passed through a blower, and then through other mixers and pickers, until finally, after many processes, it has become as soft as thistledown, and is ready for felting.

Leaving this part of the factory, we enter a great room where the men are performing operations which really look like hat making. Each hatter stands before a revolving table upon which is a felting machine, containing a copper cone a yard high and almost that wide at the base. The cone has many tiny holes in it, much like a sieve. As it moves about, the air is drawn into the cone by a fan so that a current is always flying through each hole. At the same time the cone is kept moist.

Now each workman has been given a few ounces of fur, or just enough for a hat. He feeds this to the felting machine, and the fur comes out from it so that it is caught by these little currents of air and thrown on the cone. The thousands of fine hairs soon coat the cone, and in a moment or so they become a connected mass of thin felt. The cone is now taken out of the machine and dipped in water, after which the fur coating, which is now felt, can be pulled off and shaped into a hat.

As it comes off, it looks more like an open bag than a hat. It stands as high as our waists, and it must be shrunk and molded to shape. This is done by plunging it again and again in hot water. After each

bath the cone grows smaller and smaller; and, by manipulation, it is finally molded into the form and size of the hat, including the crown, sides, and brim as we know them.

After this the hat must be dyed, and, if it is to be stiff, it receives a coat of shellac. It must also go through certain finishing processes to make it smooth and glossy; and if of a fine quality, it may be polished with emery paper. It must be trimmed. A silk band must go around

Trimming room in a hat factory.

the crown, and a strip of sweat leather inside; in many cases silk bindings are sewed to the brim. All together we see that the making of the simplest hat requires many men.

We realize this more and more as we think of the far-away countries from which the materials come, and the many different people who handle them. The price of each hat must include the pay of many men. The hunters who trapped the various animals will each have his share, and so will the traders who bought the skins, as

well as the sailors who managed the ships which carried them to the markets. Another small portion goes to the East Indians who made the shellac from the resin on the trees of their country; and some to the natives of Italy, China, or Japan who grew the raw silk found in the trimmings and bindings. The price will have in it the leather of the sweat band, made of the skin of a goat owned by an Arab on the edge of the Sahara; and also something for the rubber in the string which keeps it from flying away, and which perhaps was gathered by an Indian on the banks of the Amazon River. Indeed, these hats of ours, which we knock about so freely, are striking examples of some of the wonders of commerce and industry; and we should respect them on account of their travels and of the many people who have taken part in their making.

30. HEAD GEAR OF STRAW AND OTHER MATERIALS

THE head gear we have so far considered is largely for cold weather wear. In the fall, winter, and spring we have wool and fur hats to keep our heads warm, but in the hot days of the summer we need something that will ward off the sun, and also be light. For this reason our summer hats and bonnets are made of straw, palm leaves, and wood splints; and when we go to the hot lands of the equator, we take huge helmets, lined with pith or cork bark, to protect our heads and necks from the strong rays of the sun.

The most common summer hats of America are made of palm-leaf splints or of straw braid. The straw is grown in different parts of Europe and in China and Japan, and braided by the people there. Some of our finest braid comes from Italy. It is of wheat straw, cut when ripe, and dried and bleached in the sun. After this it is cleaned, and again bleached by passing it through sulphur fumes. The straws are sorted before they are used. The famous Leghorn hats are the finest of this kind, the best of them being braided by hand. The work of making the Leghorn braid is so delicate and trying to the eye, that the men engaged upon it cannot work more than two hours at one time.

A great deal of straw braid is made in Switzerland, where the children help their parents by plaiting braid out of school hours; and also in parts of Germany where schools have been established to teach the children how to prepare the straw for braiding. In Italy the straws are used whole; in Germany and Switzerland they are split and then plaited; in China and Japan both whole straw and split straw are used.

After the braid comes to the United States, it is sewed together into caps, hats, and bonnets. It is first dampened that the straw may not break, and the workmen begin their sewing at the middle of the crown. In this way, the first few rows are put together by hand. Then the straw-sewing machine is used, and this works so rapidly that a single machine can turn out one hundred straw hats in one day. After sewing, the hats and bonnets are stiffened by brushing them with glue; and then shaped upon blocks by machines which exert a great pressure.

Sewing straw braid.

Our cheapest hats are woven out of the split leaves of the palm tree. We make light hats of the poorer varieties of silk, and of mixtures of straw, horsehair, and ramie. We also have hats of ramie braid, and of braid made of horsehair, silk, cotton, flax, and other materials. Our people of the Philippine Islands manufacture beautiful hats of fine straw, and the Manila hat is amongst the lightest sold in our stores.

Some of the best of our summer head wear is imported from other countries. This is so of the Panama hat, the finest variety of which is so light that one can scarcely feel it as it rests on his head; and so costly that ten, fifteen, or

twenty dollars is not a high price for a hat. There are Panamas which sell in the place they are made for as much as one hundred dollars apiece.

This hat is called the Panama, because it comes to our country and Europe by way of the isthmus of that name. The chief seat of its manufacture is Ecuador, although some hats are now made in Panama and also in parts of Colombia as well. We have also fine palm-straw hats from Porto Rico and the Philippines.


Palm trees, Porto Rico.

As we look at these hats they seem to be woven of straw. They are, in fact, made of the fibers of certain palms which grow wild in the swampy lands of various countries. The best palm is found in Colombia and Ecuador, where it is cultivated in the principal hat districts. The tree is small, but it grows to full size eighteen months after planting, and it will live for forty years or more. The leaves are plucked off when they are young, tender, and just beginning to open. The fibers are then taken out and boiled in a

mixture of water, salt, and lemon juice to whiten them. They are afterwards bleached in the sun.

The work of making the Panama hats is done chiefly by the native women. They plait the fibers on a block, beginning their work at the crown and finishing it at the brim. The cheaper hat, such as sells for several dollars in this country, can be made in three or four days, but the more expensive ones take two or three times as long, and those of a higher grade may consume several weeks. The very choice hats, which sell for as much as one hundred dollars, are chiefly made in the province of Manibi, Ecuador. There are only a few weavers who understand how to plait them. The fibers are exceedingly fine, and the work is done only during certain hours of the day when the air is just right. It takes five or six months to make the finest of the Manibi hats, and very few are offered for sale.

"They plait the fibers on a block."

It is in that same province that most of the Panama hats are made, as many as eight or nine thousand being turned

in one month. The chief center of the manufactu- the canton of Jipijapa (he-pe-hä′pȧ), for which reason nama hats are sometimes known as Jipijapa hats, Jipi-pa being also the native name for the palm from whose eaves the hats come.

In addition to the head gear we have already examined, there are hats, caps, and bonnets for men, women, and children made of silk, wool, and cotton cloth, sewed together in various shapes, and we have knit caps and hats of different kinds. We have also women's bonnets of silk, satin, and velvet, ornamented with leaves, flowers, and feathers; and men's tall hats of silk plush, which look like stovepipes with brims fastened to them. We learn that each of these must go through certain processes of its own, and we can easily see that all together the hat-making industry covers a wide field, employing a vast number of men, women, and children, and, in one way or another, embracing almost every part of the earth.

31. FEATHERS

IN our National Museum at Washington is shown a cape, which has cost more, I fancy, than any fur garment ever worn. It was made long ago for one of the kings of the Hawaiian Islands. He was conquered and killed in battle by another king; and the latter gave this cape to a captain of the United States navy, who presented it to the Museum. The cape is composed of network of native hemp to which are sewed the feathe of two kinds of birds found only in our islands. I

entire body is covered with these feathers, so arranged that it forms a gorgeous garment of brilliant red and yellow. The red feathers are not difficult to get, for the birds which furnish them are numerous. The yellow ones come from a little bird which has only one or two of this color under each wing; and which is so rare that it took many, many years to gather all the feathers in this splendid mantle. The birds were captured alive in traps, and when the precious plumage was pulled out, they were set at liberty. It is said that the kings who governed these islands before we took possession of them, prized these feathers so highly that they were used as money and were taken by the government in payment of taxes. Garments made of them were then considered amongst the choicest possessions of the crown; but the capes are now more of a curiosity than anything else, and no one would think of attempting to make them for sale.

Feather cape from Hawaiian Islands.

We all know that feathers are largely used by women to decorate their bonnets and hats. They are in such demand all over the world, that men make a business of hunting birds for their plumage alone. There are some countries, such as Africa, where raising ostrich feathers is a regular business; and others, like Abyssinia and the deserts of Sahara and Kalahari, where hunters and trappers devote

themselves to chasing and killing ostriches for their feathers. Moreover, in many of the larger cities are great establishments which make a business of selling feathers of various kinds; and there are factories where they are cleaned, dyed, and curled for the market. We do not believe that it is right to kill birds for such purposes, but in our travels through the world of commerce and industry, we must learn all about what man makes for sale to his fellows, and we shall therefore consider this business which involves the slaughter of many of our feathered friends.

Much of our most brilliant plumage comes from the warm lands of the globe, such as the Amazon Valley, where there are parrots, toucans, and other birds of gorgeous hues. From our own country we have wild geese and ducks, and also the pheasant, the eagle, and grebe. The skins of the latter are in great demand for women's muffs, hats, and dress trimmings, and thousands of the birds are sacrificed yearly to supply it. From far-off Australia we get the feathers of the emu; and from the deserts of Patagonia the gray rhea, or

Marabou.

South American ostrich, whose glossy feathers are used for military plumes. As to the ostrich itself, the chief bird of commerce, we shall make an especial visit to it a little farther on in our travels.

Some of the most beautiful feathers used for ornamentation come from various storks. The marabou, for instance, which lives in India, has a plumage so soft and light that it brings almost its weight in gold. It is in great request for muffs and boas, and is sometimes worn in the hair.

Another feather used for hair decoration is called an egret, from a small white heron of that name. The feathers are long and slender, and they spring from the back of the egret during its breeding season. The birds are often killed, and great cruelty is sometimes used in obtaining the plumes. These feathers are costly, and they are frequently set in gold and precious stones, and so worn on the top or crown of the head. They are in demand in Oriental countries, where men sometimes wear them on the fronts of their turbans, fastening them there with diamonds or other precious stones. Egrets are used on

Egret.

certain military hats; as are also the feathers of the osprey, a sort of fishhawk found in different parts of the world.

If we would see some of the most brilliant birds upon earth, we must fly across the Pacific and drop down in the great island of New Guinea. That savage country, not far from the equator, has a kind of pigeon almost as big as a hen turkey, with feathers of a brilliant light blue. Its neck glistens like an opal, and it has a crest of tiny blue feathers, running high up from the back of its head, which, as the sun shines, look as though they were sprinkled with jewels. In New Guinea there are red birds, and parrots of gorgeous hues. There are tiny humming birds, of the most brilliant plumage, and also birds of paradise, whose feathers are so glorious that they are sought for by hunters and sent all over the world for the decoration of head gear.

Bird of paradise.

Birds of paradise belong to a family related to the crow, and they vary in size from that of a crow to a sparrow. The males have feathers of many colors growing in tufts out of their shoulders. The plumage is soft and velvety. The plumes are so long that they sometimes reach out over the body and even far beyond the tail. Other birds of paradise have feathers

extending out like enormous ears or horns, from the back of each eye.

Some birds of paradise are green in color, and others are of a velvety red with the under parts white and with plumes of purple tipped with green.

These birds, so the natives of New Guinea tell us, have dancing parties at which a score or less of the males come together and dance about from branch to branch, raising their wings, stretching their necks, and elevating their exquisite plumes. It is believed they do this to attract the females. At such times the birds become too much engrossed in their play to be cautious, and the natives, who are secreted in the tree tops, shoot them, using blunt-headed arrows that they may not injure the plumage. After this the skins are cured by smoking, and then sent off to the markets.

Crossing over to Australia, we find the lyre bird, whose green and black feathers are largely used for hat decoration, and also the emu, which looks much like the ostrich, save that its feathers rather resemble coarse hair than anything else. In New Zealand we see black swans with velvety plumage, and also the black parson bird, which has white feathers at its throat like a parson's white necktie.

In Europe there are many places where domestic fowls, such as swans, peacocks, chickens, and geese, are reared, that their feathers may be used for decoration; and off the coast of Norway we find flocks of the eider duck, whose soft, velvety down is frequently used for collars, muffs, and clothes linings, and more often for stuffing bed covers. The eider down, as these fine feathers are called, comes from the bodies of the old ducks. When the mother duck begins to lay her eggs, she pulls the down from her breast

and lines the nest with it. After the baby ducks are hatched out, when she flies off for food, in order that her little ones may be protected from the cold, it is said that she pulls out more down and covers them with it as a blanket. The hunters find the nests and gather the down, which is then cleaned and shipped off to the markets. The men are careful not to destroy the nests, and they take away only the feather linings. After this the ducks will line them again, but not more than once. If they are twice robbed, they conclude that the place is a bad one for raising their children, and go off and build a nest somewhere else.


Eider ducks.

32. THE OSTRICH AND ITS FEATHERS

"The fleet-footed ostrich, over the waste,
Speeds like a horseman who travels in haste,
Hieing away to the home of her rest
Where she and her mate have scooped out their nest,
Well hid from the pitiless plunderer's view
Far off in the heart of the sandy karroo."

NOT many years ago all the ostrich feathers of commerce came from wild birds on the high plains of Africa. The karroo in South Africa, the highlands far-

ther north including the desert of Kalahari, the great Sahara itself, and the plateaus of Abyssinia, were their favorite homes. They were found also in the Sudan, in British East Africa, and in the deserts along the coasts of the Red Sea and Indian Ocean, where they were hunted by the natives on foot and on horseback. Ostriches are so fleet that they can race with the fastest horse, but they have a habit of running in great curves or circles so that the hunters take short cuts across their paths and thus tire them out. They are also shot while sitting on their nests, and not only they, but also their young, are killed. By such methods almost all the wild ostriches have been destroyed, and their feathers now have but a small part in the commerce of the world.

Nevertheless, the supply of ostrich feathers is far greater than ever; for it comes from tame birds, reared upon farms, like cattle and sheep. Several hundred thousand pounds of such feathers are now annually sent from South Africa to London; they are exported in small quantities from Algeria and Egypt, and are even shipped to our markets from certain of our Southwestern States, such as California and Arizona. The taming of ostriches began about fifty years ago, when a farmer in South Africa

Dealer in ostrich farm products, Egypt.

captured some of the wild chicks, and penned them up near his home. He fed them carefully, and watched them as they grew, to learn how to take care of them. After the little ostriches became large, they dug out nests in the sand, and laid eggs in them. Their young were cared for, and it was soon found that ostriches could be reared just like cattle or hogs, and their feathers plucked from year to year and sold at a great profit. Other farmers, near by, took up the business, and now there are ostrich farms scattered over South Africa, some of which have several hundred, and a few as many as two thousand birds.

In the Cape of Good Hope, alone, there are now more than a quarter of a million ostriches, and several million dollars' worth of feathers are now shipped from that province to London every year. Ostrich farms have been established in the Transvaal, Orange Free State, and at other places in South Africa, and also in Algeria and Egypt. We have brought birds from Cape Town to our Western States, and we now have several big ostrich farms in Arizona and California. The birds thrive in those regions. They are already producing many beautiful feathers, and the day may possibly come when we ourselves shall raise all that are required for our markets. Just now, however, the chief ostrich-feather country of the world is South Africa, and we shall take a trip thither to see one of the farms.

We have left the United States, and have dropped down on the karroo, a high rugged plain, which lies near the southern end of Africa. There are mountain ranges on our right and left, the dry, rocky peaks being lost in the clouds. The sides of the mountains have many

ravines running down to the flat, sandy plain. Everything is dry, and it is only the dusty brown grass, and the bushes which grow here and there, that show any sign of vegetable life. We ride on our horses for some distance over the country, before we come to our farm. As we approach it, we pass a little stream, the banks of which are covered with grass. The lands about the house are irrigated from the stream, and we can see the green lawn, when still far away. There are trees about the low white buildings, and the whole looks like an oasis in the midst of a desert.

Most of the farm is composed of this dry, sandy plain, and it forms the feeding grounds of the ostriches. They eat the thin growth of scanty brown grass, and also the

Ostrich farm.

gray stunted bushes. We observe that the farm is divided into immense paddocks, surrounded by wire fences, and that many of the fields contain great flocks of strange creatures. At a distance they look like huge black or gray bundles on legs, with long sticks rising above them and fastened to them like so many handles. As we come nearer, we see that each is a live ostrich,

quietly grazing, away out here on the plains. As we go by, some of the birds come to the fence and poke their necks over it; and when we ride up and yell shoo! they stretch out their wings and run off, seeming almost to swim through the air. They are going faster than our horses could gallop, and it is said that they can, for a short distance, keep up with an express train.

Observe the birds which are now coming here! Did you ever see such queer-looking creatures? Their legs are stark naked, and their necks bare except for the thin down which half hides the skin. They seem all body, and to be nothing but plumage. Some of the birds are gray, and some glossy black. The little gray ones are the hens, and those huge black fellows the cocks, or, as we might call them, the roosters. Notice their eyes. They are bigger than those of a baby, and their heads are so small that they seem all eyes and bills. The bills are long and flat; and, when angry, they snap them with a crack like a pistol. The sound scares us, and we jump back for fear they may bite.

"Did you ever see such queer-looking creatures?"

The legs of the ostrich, however, are far more dangerous

than its mouth. It has enormous muscles, and can kick as hard as a horse. It kicks forward and downward, striking with immense force when the foot is high in the air, and with less as it comes near the ground. If we should be attacked by an ostrich while going over the fields, it would be best to throw ourselves down. We might be trampled upon, it is true; but we should suffer less injury than if we stood up.

As we watch the great birds, their owner rides up and kindly offers to show us his farm. He tells us he has one thousand ostriches, and that he rears many chicks every year. We now get down from our horses and walk with him from field to field. Before entering the inclosures, we each arm ourselves with a long bush on which are many sharp thorns. The ostriches are afraid of hurting their eyes, and they will not run at any one who has a thorn bush in his hand.

The first field we enter is one in which two great birds are hatching. The black cock has scooped out a hole in the sand, and the gray hen is now sitting upon it. The cock rushes at us as we come near the nest. He hisses and seems terribly angry, but we hold him off with our thorns. As we approach the nest, the hen sees us; she becomes frightened and jumps up and runs off. By and by she comes back with her mate, and both move about, at some distance, making piteous noises as though begging us not to injure their eggs.

The farmer picks up an egg and shows it to us. It is as big as the head of a good-sized baby, and is of an ivory-white color with little black specks at wide distances apart all over it. It weighs about three pounds, and we are told

that it contains as much meat as twenty hen's eggs. A single egg will make a good omelet for a half-dozen people; and it takes about three quarters of an hour to boil one hard. The Hottentots sometimes cook ostrich eggs by resting them on end in hot ashes, and stirring the contents with a stick through a hole which they make in the top of the shell.

The ostrich eggshell is quite thick and difficult to break. It is so hard that the carrion crow cannot pick through it, and he has learned to take stones in his claws and, flying high up over a nest, to drop them on the eggs in order to get at the meat.

We observe that our farmer is careful in handling the egg, and that he soon lays it back in the nest. There are eighteen others beside it, so spread out that it would seem difficult for one bird to cover them all. The man tells us they must be kept well covered all night and for the greater part of the day during the hatching. The birds take turns in sitting upon them. The cock does the most work. He keeps the nest warm all night long, and the hen takes his place in the day. Moreover, he watches the hen, and if she gets off, he drives her back to the nest. The sitting lasts for six weeks, or just twice as long as is required to hatch hens' eggs.

When the little ostrich is ready to come out, it is the father who breaks the shell for him. He squeezes the egg gently between his breastbone and the sand; and, when it cracks, he pulls it apart and tears off the inside skin with his bill, and thus lets out the baby.

Let us go to another field where some of the little ostriches are. We are shown some just hatched. They

"We are shown some just hatched."

are almost as large as young chickens. Their bodies are covered with a soft, dark-brown fuzz, and they waddle about like so many ducklings. The farmers tell us they are delicate and must be carefully handled. They are first fed upon grass cut fine and mixed with bits of ostrich egg-shells, ground up. After a few days some bran or soaked corn is given them, and also a little gravel which they will carry in their little gizzards to grind up their food.

The ostriches are almost a year old before their first feathers are ready for plucking, and even then the plumage is stiff and narrow, with pointed tips, so that it is not of much value. A year later, the feathers are better; but it is not until the third year that they have their full width and softness. They increase in value up until the fifth year, when the bird is full grown, and are good from that time on, for many years. The ostrich often reaches the age of three-score and ten; and it sometimes produces one hundred dollars' worth of feathers in one year.

Before leaving the farm, we see several birds plucked.

A flock of ostriches has been driven into a narrow inclosure, and the black Kaffirs, each armed with a thorn bush, are now moving about among them. They take out the birds, as directed by the pluckers; and, by means of the thorns, turn each into one of the small pens which have been built along one side of the field. These pens are so narrow that the ostriches have just room enough to stand in them; but not to move around or to kick. As the bird comes in, the gate is slammed behind it, and then a long bag of cloth, like a stocking, is drawn over its head. Then the two pluckers, one of whom stands on each side of the box, raise up the wings, and with sharp shears cut off the long, beautiful white plumes which grow there. There are twenty-five on each wing, those of the male perfectly white and those of the female white tipped with gray or yellow. After this the shorter wing feathers, which are used as ostrich tips, are taken off; and then the beautiful tail feathers, of which there are sixty or more. The tail and wing feathers are the most valuable, and those grown by the cocks are the

Plucking an ostrich, Australia.

best. About three hundred feathers are secured from each bird.

The plucking of the ostriches must be carefully done. If it is just right, the roots of the feathers will shrink within a short time after cutting, so that they may be pulled out without hurting the bird, and thus allow new feathers to grow. The plucking is done every seven or eight months, or about three times in two years.

Raw ostrich feather.

The feathers are graded into different lengths and colors. They are then tied up in bundles and sold by weight to merchants, who ship them to the ports, whence they are exported to London, New York, and other feather-manufacturing centers.

In London there are feather auctions every two months, and many of the chief feather dressers and dyers go there to buy. After the feathers are sold, there is much to be done to them before they are ready for use. They must be washed, curled, and trimmed, and then dressed or sewed into shape. The washing is done by scrubbing them with soapsuds, upon boards much like

those used in clothes washing. The feathers are next curled by passing the edge of a blunt knife over them, and trimmed by cutting off the quills and undesirable portions. After this they are put through other processes to make them fluffy and glossy. The fine white and black feathers are usually sold in their natural colors, but the gray and yellow ones are often dyed.

Curled ostrich feather.

In using the plumes of the ostrich, two or three quills are sometimes sewed together that the feathers may be thicker; and in the manufacture of boas or dress trimmings, many ostrich tips are joined into one long band; or into the thick fluffy rolls which women so delight to wear around their necks.

33. WET-WEATHER CLOTHING. TRAVELS IN RUBBER LANDS

WE must take our mackintosh coats and high rubber boots with us to-day. We are to have a long march through the woods on the banks of the Amazon

River, where the rain pours down in torrents, and where, at almost every step, the ground oozes moisture. We are bound for one of the rainiest regions on earth, to find out about the rubber so largely used in our rainy-day clothing.

Rubber is a child of the sun. It delights in warm weather and thrives best on or not far from the equator.

On the Amazon.

It comes from the sap of certain vines and trees which grow abundantly in hot, moist lands. Most of our rubber for automobile and bicycle tires and other purposes comes from plantations of cultivated trees in Malaysia, Sumatra, and Ceylon. But there is also wild rubber in Africa and in southern Asia, in Borneo, Java, and other islands of the East Indies, and especially in South America. The best of the wild rubber of commerce comes

from the sap of trees of the species known as *Hevea Brasiliensis*, which grow wild along the Amazon and its tributaries. That great river system covers an immense area; and the rubber territory there, if it could be lifted up and spread over the United States, would hide almost one third of our country. The valleys slope gently, and they are flooded a great part of the time. Besides, the rainfall is enormous. Seventy-two inches of water drop from the clouds every year, and the air reeks and steams. It is on such lands that the best of the rubber trees grow, and it is through some of them that we shall travel to-day.

Before we start out, let us take a bit of rubber, and ask it to tell us what the family, to which it belongs, is doing over the world. We shall have no trouble in finding a sample. Take the tip of your lead pencil, the elastic band around your hat, or the rubber ball with which you played before coming to school. They all have their brothers and sisters, scattered far and wide over the globe, acting as the little rubber servants of humankind. They begin their work on the babies, for the little ones have rubber rattles with which to play, and rubber rings for cutting their teeth. For older children, are made rubber toys of various kinds, and then come balls for baseball and football, which alone consume more than a million dollars' worth of rubber each year. Some children ride to school upon bicycles, the tires of which are rubber; and, during wet weather, most of us go about in rubber shoes. There are forty or fifty million dollars' worth of rubber footwear made in our country every year; and there are many thousand workmen engaged in its manufacture.

As to rubber clothing, we have one factory in Massachu-

setts which turns out fifteen hundred garments every day; and the rubber annually used for our cloaks and coats weighs thousands of tons. It is estimated that about twenty million men and boys in the United States are now using elastic suspenders; and most of our women and girls have this material, in one shape or another, in parts of their clothing.

There are many things for which hard rubber is employed. We comb our hair with rubber combs, fasten our clothes with rubber buttons, and sometimes use knives with handles of rubber. We have rubber penholders and ink wells, and most of our mistakes are wiped out with rubber erasers. Rubber is one of the great friends of the sick. In the shape of the hot-water bottle it warms their cold feet, and, in bags filled with ice, it cools those who have fever. There is nothing else so pleasant for bathing as a rubber sponge, and even hairbrushes and toothbrushes are now made of this material.

Rubber is employed in many kinds of machinery. It is wrapped around electric wires, to insulate them; and electricians sometimes wear rubber gloves. It is combined with various fibers to make the hose used for fire engines, and also that with which we water our lawns. It forms the valves of the engines of the big ocean steamers; and the passengers often have rubber life-preservers in case of a wreck. Race horses are now shod with rubber, and rubber blankets are used by both horses and men. There is no easier riding than in a rubber-tired motor car, and every motor truck has its wheels cushioned in a similar way. The uses of rubber are so many that we cannot see how man could do without it.

Still, our great-grandfathers used very little of this material, and their great-grandfathers none at all. It is only within the past half-century or so that rubber has been an important article of commerce. Its character was ascertained shortly after Columbus discovered America. One who went with him on his second voyage wrote that the Indians of Haiti made elastic balls of the gum of a tree and played games with them. A little later the Spaniards found that the Aztecs of Mexico were using the gum, and they learned from them how to smear it over their coats to keep out the rain. Shoes of pure rubber were brought from the Amazon to Europe several hundred years later; and it was not until 1844 that an American, Charles Goodyear, patented a process by which the sap or gum could be so hardened and otherwise treated as to be of great value to man. We shall learn more of this farther on in our travels.

Here we are at Para, at the mouth of the Amazon River. This is the chief of all ports for wild rubber. Those steamers at the wharves have come from the United States and Europe, bringing supplies for the rubber camps, and they will take back cargoes of rubber, Brazil nuts, and other Amazon products. This country produces more than seventy million pounds of rubber every year, and most of this is brought down the Amazon and shipped from Para.

There is a small steamer unloading now. Negro porters are carrying great baskets filled with what look like little smoked hams on their heads. They are taking them into those huge warehouses on the banks, singing a Portuguese song as they go. But look! a porter has stum-

bled and his basket falls to the ground. The hams are jumping and bouncing about as though each were alive. One has rolled off the wharf, striking a stone block far below. See how it bounds high up into the air! Those hams are all rubber, and it is in that shape that the raw material comes to the market.

We see carts, loaded with rubber hams, hauled by mules over the streets, as we walk through Para. There is a rich smoky smell about the warehouses, and, as we look in through the open doors, we can see men cutting the hams in two to find whether they are pure rubber all the way through. The cut hams look much like layers of dirty cheese, folded together with smoked streaks running through them. They are packed in pine boxes of three hundred pounds each; and labeled for New York, Hamburg, or London.

"The cut hams look much like layers of dirty cheese."

We spend a day or so at Para, going through the large stores filled with supplies for the camps, and chatting with the merchants and exporters about rubber. They tell us that their product all comes from one to two varieties of trees scattered over the forest. They do not grow close together, and a man has to walk several miles in gathering his rubber sap for the day. We are told that some trees are to be found near Para,

but that we shall see them better if we go on far up the river.

A day or so later we take a steamer and make our way inland. The Amazon is wide, and we are sometimes so far out that we can just see the banks. Now and then we are close to the shores, and the huge trees almost hang over our vessel. There are gay-feathered toucans and chattering parrots among their branches, and the monkeys gibber at us as we sail by.

On the third day we reach Manaos, another great rubber port. It is a large city with electric lights, tele-

"On the third day we reach Manaos."

phones, and street cars, in the heart of the Amazon forest. It is a supply point for the many camps along the Negro, the Madeira, and the Marañon, the rubber being sent to

Manaos for shipment to the market. There are boats from all these rivers lying at the wharves; and we take passage on a small steamer which carries us thirteen hundred miles farther up this mighty system of waterways to the town of Iquitos (e-ke′tos), on the edge of Peru. We are now almost as far from Para, as Para is from New York, and in a country from which quantities of our best rubber come.

We hire small boats and are rowed off into the forests, visiting one little camp after another, and spending many days in watching the Indians and negroes gathering the juice and making it into rubber hams like those we saw at Para.


Collecting sap.

We are much interested in the trees which furnish the rubber, and soon learn to pick them out from the others. As already stated (p. 242), they are known by the name *Hevea Brasiliensis*. They are not at all like the rubber plants grown in our hothouses, but are great trees with silver-gray bark and leaves like an English ash. In August they have white blossoms; and along about Christmas they bear quantities of little nuts inclosed in shells, which, when ripe, burst with a noise like the crack of a pistol, scattering the nuts to some distance. For this reason the trees are usually found so wide apart that one man cannot collect

the juice from more than one hundred or one hundred and fifty trees. Each hand is allotted so many along what is known as a rubber path, and he must often travel miles in his day's march from tree to tree and back to the camp.


Tapping a rubber tree.

The rubber comes from the juice of the tree. This is not the true sap, although that word is often used in describing it. It is a milklike fluid that oozes out of the bark when cut, and which contains little globules of rubber that rise to the top like cream when the milky juice is allowed to stand. The process of getting out the rubber consists of tapping the tree, collecting the juice, and so treating it that the water in it is evaporated and only the rubber is left.

But suppose we go out with the men at this camp where we now are, and make some rubber ourselves. Each of us is given a hatchet with a blade an inch wide, a dozen

or so little tin cups with sharp rims, and a gourdlike bucket, in which to bring our rubber milk home. We go along one of the paths and make slight gashes in each rubber tree with our hatchets, cutting well into the bark, but not touching the wood. As we do so, the milk begins to ooze forth in white tears. We now make another cut below our first gash, and there fasten a cup by its sharp rim so that it will catch the rubber tears as they fall. We then cut a gash in another place for a second cup, and so on, fastening several cups to each tree. This consumes the greater part of the morning; and when we have finished tapping the trees and attaching the cups, we are far away from the camp.

Going back, we gather the rubber from our own and the other cups on the trees, getting only a spoonful or so from each. We empty many cups, and, by the time we have returned, each has a gallon or more of this white rubber juice. It looks like milk, and is of about the same thickness. We thrust in our fingers and taste it. It is sweet, but not fit to drink. The rubber gatherers tell us that the juice flows most freely in the morning, and slower and slower as the day goes on. The air coagulates it, and after a short time it closes the wounds with rubber stoppers, as it were.

We pass many trees that have been tapped again and again from season to season. Their trunks are swollen and scarred by the wounds of the hatchets. Tears of yellow rubber hang down under the wounds in the cracks of the bark. These tears are pulled out when the cup is taken away, and sold as scrap or second-grade rubber.

Here we are at the camp, ready to turn the juice we

have collected from the trees into raw rubber such as we saw at Para. This is done by smoking and evaporating it over a fire. To make the best rubber, the milk must be smoked on the day it is gathered. We take some palm nuts and palm leaves, and place them under a little clay chimney arranged for the purpose. This fuel burns quickly, and a dense smoke soon pours forth. In the meantime we have emptied our tree milk into a big round bowl, much like that in which our mothers knead bread. Each of us has a wooden paddle with a long handle attached. He dips this into the bowl, and it comes out the color of snow. The milk has stuck to it and coated it white. He now thrusts the paddle into the smoke, and twists and turns it about, in order that the juice may be evenly warmed. In a moment or so the heat has driven out the moisture, the smoke has hardened the milk, and he has a paddle covered with rubber. Now the paddle is again thrust into the bowl and a second coat of rubber is formed in the same way. Another and another layer is thus put on; and at last a great round lump of rubber is built up on the end of the paddle. This is now cut open, and the paddle pulled out.

Smoking rubber.

"Another and another layer is thus put on."

The lump is of the shape of a ham, only made up of these many layers of rubber. In smoking, the juice has lost its beautiful white and has become a mixture of yellow and brown. It seems dirty and greasy, and it looks for all the world just like a ham weighing three or four pounds.

In other parts of the world rubber is collected from many trees, different from those of the Amazon. It comes also from vines. There is vine rubber in Central America, southern Asia, the Dutch East Indies, Madagascar, and Africa, most of which countries have rubber trees as well. The vine rubber is sometimes gathered by cutting down the vines and stripping off the bark. In the Philippine Islands we have rubber vines, three hundred feet long and seven or eight inches thick. They grow on the tall trees of the forests. The natives pull them down and tap them at places three or four feet apart. They then catch the sap in cocoanut shells, and harden it by pouring into sea water. The result is a mass of solid rubber, which is white, tough, and elastic, but which in a short time turns black and begins to rot.

Much of the rubber collected in Africa comes from

certain creepers known as the Landolphia. The natives, after tapping the vines, catch and smear the milky juice over their naked bodies. It soon hardens, by the warmth of the air added to that of their persons, and they then pull it off and roll it up into balls. In some parts of Asia the milk is turned into rubber by means of alum, and in others by boiling it in water. In Ceara (se-ȧ-rä′), a province not far south of the Amazon, the collectors brush away the ground at the base of the trees, and spread down palm leaves. As the juice hardens, it is stripped off and packed up for shipment.

Various countries have still other processes of gathering this valuable product. In many places the rubber is collected by savages in such ways as cause the death of the vines and trees. Only a small amount of rubber, often not more than a few pounds, comes from each tree or vine in one year, so that it is difficult to get all that is needed by man. This material is so widely used that the supply from wild vines and trees is not sufficient for the demand, and rubber plantations have been set out in many localities. This is so in Mexico, Brazil, and the Kongo Valley, and also in certain of the West Indies, and in Java. We are setting out some rubber plantations in our Philippine Islands; and in Malaysia, Sumatra, Singapore, and Ceylon the Para rubber tree is profitably grown in large numbers. Two hundred and fifty Para trees can be raised on one acre, and at the age of six years each will produce about one pound of rubber per year. At twelve years, the annual yield is six pounds for each tree, and if carefully tapped, the trees will continue to give that much every year for many years.

34. HOW RUBBER IS MANUFACTURED

IS it not strange that India rubber, which is now found in so many vines and trees and in nearly every part of the tropical world, should have so long remained unknown to man? The Spaniards who saw the copper-skinned Indians of Haiti playing with rubber balls considered them a curiosity only; and the soldiers of Cortez who were taught by the Aztecs to spread it over their coats to keep out the rain did not imagine that many millions of civilized people would sometime use it for that very purpose. The Spaniards, in making their discoveries, were seeking for gold; but they overlooked the vast fortunes hidden under the bark of the India rubber trees from which have since come more money in a single year than all the gold and silver that the Spaniards ever took out of South America in any one year.

The Amazon was discovered by Pinzon in 1500; but no one knew of its rubber resources until a French scientist named La Condamine descended it from Ecuador in 1744 and brought with him to Europe some rude bottles made of the milk-white juice of certain trees which grew there. He said that the Indians called the stuff cahuchu; and the French from that named it caoutchouc (kōō′chōōk), a word which is often used for rubber. A little after this it was found that the material would rub out pencil marks; and from that fact the English gave it the name of rubber. One of the first records of its use as an eraser is in the works of Dr. Joseph Priestley, an English scientist who came to the United States while George Washington was

President. Dr. Priestley had cubes of India rubber, which were much smaller than those we now buy for five cents. They were half an inch long and sold for seventy-five cents.

The first waterproof cloth was manufactured by an Englishman in 1797, but it would not stand heat; and it was not until 1823 that Charles Mackintosh of Glasgow discovered that he could dissolve rubber in naphtha, and thereby form a varnish which, when spread upon cloth, would make it really waterproof. That was the beginning of our wet-weather clothing. The development of the process resulted in the rubber coat and the mackintosh, and in the great variety of rubber garments which are now worn all over the civilized globe.

It remained, however, for an American to produce the most valuable of all rubber inventions. This was the process of vulcanization, through which a mixture of India rubber and sulphur, by means of heat, are made into the elastic, enduring, and heat-and-cold-defying material we now use. Before this was discovered, all India rubber was brittle in cold weather and sticky in warm weather; and of such a nature that it was impossible to use it in the many manufactures where it now has a great part.

This discovery was made in 1839 by Charles Goodyear, whom Daniel Webster classed among our greatest inventors, placing him in the same rank with Robert Fulton, the father of the steamboat; Eli Whitney, the inventor of the cotton gin; and Samuel B. F. Morse, to whom we are largely indebted for the electric telegraph.

Charles Goodyear was born in Connecticut in 1800. He began life as a hardware dealer, but he devoted all his

spare time to the study of rubber, and to experimenting on how it might be hardened and still be elastic. Some rubber shoes, made of the pure gum, had been imported from Brazil, but they softened during the summer and gave out a bad odor. Rubber was then cheap; and Goodyear saw that if it could be hardened, shoes made of it might be worn in wet weather throughout the year, and that it would come into general use. He spent all his money in trying to find out how to do this, and then borrowed more. At times he was not able to meet his obligations and was thrown into prison for debt. It was during this part of his life that one who knew Mr. Goodyear, upon being asked to describe him, replied: —

"If you meet a man who has on an India rubber cap, coat, vest, and shoes, with an India rubber purse, which has not a cent in it, you may know it is he."

After a time Charles Goodyear found that he could change the character of rubber for the better by treating its surface with nitric acid; and he thereupon began making rubber shoes and toys. This business was a failure, and he then experimented on hardening rubber by mixing it with sulphur. He got this idea from Nathaniel Hayward, who claimed to have had the process revealed to him in a dream, and who had taken out a patent upon it. Goodyear bought the patent; but the process was not a success, until, one day when he was trying to bake a mixture of sulphur and rubber on his kitchen stove, some of the gum fell out upon the hot iron. Instead of melting as usual, the stuff hardened like leather, and the inventor thereupon discovered that great heat would make rubber hard. He took this piece of rubber, and nailed it

to the wall of his house, outside, to see how the frost would affect it. The next morning it was as elastic as ever, and had none of the brittleness common to the cold rubber of his previous experiments. He then went on until he learned just how much sulphur should be mixed with the gum, and how great heat was needed for vulcanization.

Charles Goodyear took out his first patent on this invention in 1844; and it is upon it as a basis that have grown up the great rubber industries of to-day. From time to time, improvements have been added to make the vulcanized rubber soft, and we now have vulcanized rubber in both a hard and soft state.

The hard rubber is called vulcanite, or ebony. It contains more sulphur than soft rubber and is cured by a greater heat. It is of a brownish black color, is hard and tough; it cuts easily and takes a good polish. It is largely employed for combs, breastpins, bracelets, and in electric machines.

The soft vulcanized rubber has other materials, such as white lead, zinc white, and whiting added to the sulphur, to give the mixture color and softness. It is used in the manufacture of waterproof cloth, boots, shoes, mats, toys, tires, hose, pipes, and other such things.

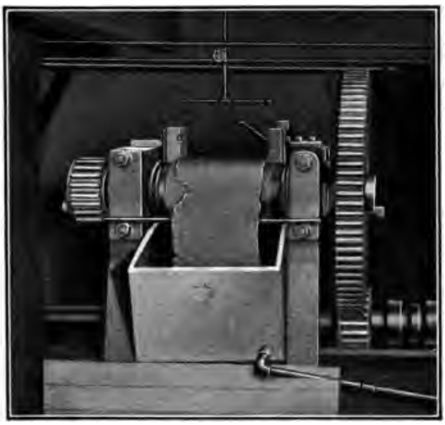
Both hard and soft rubber are manufactured to a greater extent in the United States than anywhere else, and we can learn all about them at home. Suppose, for instance, that we wish to know about boots and shoes. Our factories turn out several hundred thousand pairs every day; and, as to bicycle, automobile, and carriage tires, we make them by the millions each year. We annually produce many hundred miles of rubber hose to water our lawns

and gardens, and miles of large rubber pipes for railroad cars and fire engines. We consume tons of crude rubber in the rings used in sealing our cans of preserves; and still more in our waterproof coats and in the belting and packing of machinery and in typewriter rollers. We employ many million dollars' worth of rubber in making mechanical goods. The school children of New York alone use ten thousand pounds of rubber in ink erasers each year, and the children of the whole country consume many tons in their rubber balls, toys, and other playthings.

Suppose we follow the rubber we have made far up the Amazon to one of our factories. We go down the mighty river with it to Para, and take passage on the same steamer which carries it to New York. We stop there to see it unloaded, and a day or so later find ourselves at the great factory in New England to which it has been shipped by train. We watch the men there open the boxes in which the rubber was packed at Para, and the rich smoky smell which comes forth takes us back to our fires of palm nuts at the camp in the Amazon wilds. We pick up some of the hams and look at them. How greasy and dirty they are! They have leaves and twigs in them and are gritty with sand. The rubber which has come in from other parts of the world lies all about us, and we see that most of it is far worse than our own. All must be softened, and every bit of dirt taken out, before it will be fit for use in the factory.

This is done by giving the stuff a hot bath, and then grinding it fine and washing it clean. Our rubber hams are thrown into a steaming tank, and allowed to lie there

several hours. They are then taken out, cut up in small chunks, and thrown into the washers, which are massive steel rolls, so grooved that they crush and mangle the rubber as it passes between them. At the same time small streams of water from above play down upon the rolls, washing the rubber and carrying away the leaves, sand, and dirt. They also drive out some big brown long-whiskered rubber bugs, which must have crawled into the hams at our rubber camp on the Amazon, and have been living there for more than a month, without food and with but little air.



Courtesy of "The India Rubber World."

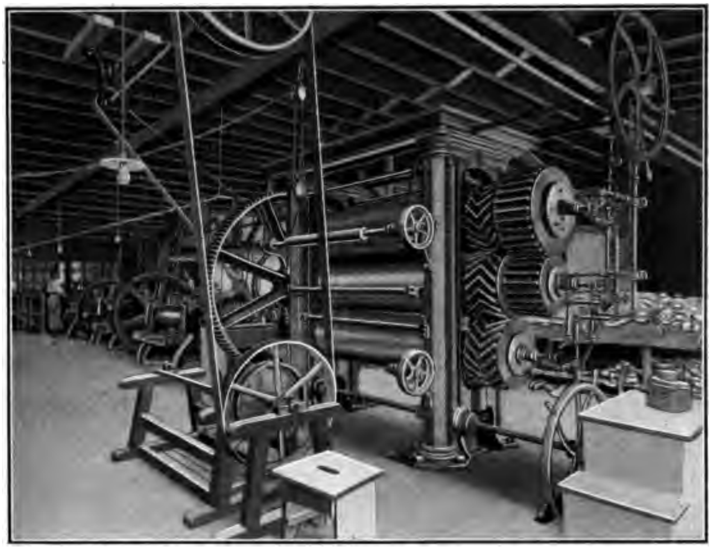
Washing rubber.

The washers knead the rubber as it goes through. In its raw state it is so sticky that the little pieces will unite as they touch; and they come out in a continuous sheet of rubber several feet wide and ten or more feet in length. This sheet is rough; there are lumps and bumps all over it, and it looks somewhat like a thick Turkish towel. It is now taken off to the hot drying rooms, where it is left hung up like leather until every bit of moisture has dried out.

After this, which may be several weeks later, the rubber is ready to be mixed with other materials for vulcaniza-

tion. It is taken out of the drying rooms, and put through machinery which kneads it like dough, and in which it is united with the sulphur and certain metals in just the right quantities to make the best rubber. We see this done as we go through the vast rooms filled with heavy rollers and grinders. The rubber is tough, and it requires an enormous force to work it. The machines roar as they move, washing and grinding the mixtures. Now and then we hear explosions like pistol shots. They are caused by the bursting of the air bubbles in the masses of rubber during the warming, kneading, and mixing. We learn that various methods are now employed according to the factory, and to the kinds of goods into which the rubber is to be made; but that all are based upon the principle which Goodyear discovered when his sulphur and rubber spilled out on the stove, and thereby taught him the possibility of vulcanization by heat.

In making the several kinds of rubber hose, and in some rubber cloths, the mixture is rolled out into long sheets between huge rolls of polished steel, called calenders, that crush the soft rubber into the fabrics which are passed through the rolls at the same time with them. In many waterproof cloths the gum is reduced to a solution, and spread over the fabric again and again, until it has a coat of rubber which is perhaps one hundredth of an inch thick. In the manufacture of boots and shoes, the mixture is spread on cloth by passing it through the calenders, and the cloth is then cut up into the pieces required for the shoes. A single shoe consists of seven or eight different parts, and these are all coated more or less thickly, the soles and heels having the most rubber on them. It takes



Courtesy of "The India Rubber World."

Calender room in a rubber factory.

more than twenty different pieces to make one boot. The parts are not sewed, but are cemented together. They are then varnished over with a preparation of boiled linseed oil and are vulcanized, after which they are ready for use.

In addition to India rubber we have another material of much the same nature, called gutta percha. This comes from trees of great size, which grow in the Malay Peninsula, and also in Borneo and other islands of the East Indian Archipelago. The trees are tapped much as those are from which we get rubber; the sap is allowed to harden, and then rolled up into rough balls or cylinders. Gutta percha is not so elastic as rubber, but it is often mixed with rubber, and is used for much the same purposes.

It is a non-conductor of heat, cold, and electricity; and for these reasons is especially valuable for coating electric cables and other things of that nature.

35. JEWELS

IT would be fine if we could each have an Aladdin lamp, like that described in "The Arabian Nights," for our travels to-day. We are going over the earth to learn about the gold and silver, and the precious stones and other jewels which man wears; and we shall need the slaves of the lamp to open the world's treasure vaults.

The desire for personal adornment is so great that man will do almost anything to supply it. That we may have rings on our fingers, bracelets for our arms, and jewels to decorate our hair or our clothing, thousands of men and boys are toiling deep down in the earth, getting out the precious metals and stones. Off the coasts of Australia and the Philippine Islands, about Ceylon, and in the Persian Gulf, they are diving into the ocean to look for pearls; and, in the half desert lands of South Africa, they are digging away, day and night, for the diamonds found there. In Burma the natives are mining for rubies for us; and in parts of China, Siberia, and northern Africa they are always searching for the green emeralds we prize so highly.

It is the same with the sapphires, topazes, and turquoises, found in the various parts of the world; of the beautiful red and pink coral, which is built up by tiny creatures in the Mediterranean and other seas; and of the golden-

hued amber, so abundantly found in the waters of the Baltic. It is so of the opals of Australia and Mexico and of many beautiful stones and shells of our own country as well. Old Mother Earth has her jewels hidden in widely scattered places all over her, and we must travel far and wide if we would learn of them all.

Antique Earrings.

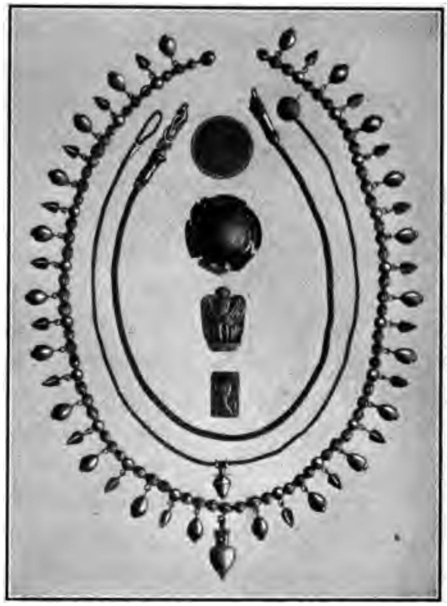
Property of the Metropolitan Museum of Art.

The time when man began to search out things for his personal adornment, was before the beginnings of history. Just what the first jewelry was, we do not know. Among the people of the coast lands, it may have been shells, such as were worn by our Indians, and are now worn by some tribes in our far-away islands. The savages of the interior may have used feathers like those now worn in Central Africa, or pieces of bone or ivory, or possibly the rude ornaments of copper and iron affected by the wild people of some other countries.

We know that man soon began to wear gold, and that he employed that metal in early Bible times. Pharaoh, king of Egypt, put his gold ring on Joseph's hand, and his gold chain around his neck; and later, before the Hebrews, led by Moses, left Egypt, the Bible tells us that they borrowed "jewels of silver and jewels of gold" to take with them. From the tombs of the Nile Valley, which were covered up by the sands of the desert for thousands of years, the people of to-day have taken out golden neck-

laces, breastpins, and rings; and on the black, shriveled arm of one mummy queen, they found four bracelets which that old Egyptian lady is supposed to have put on five or six thousand years ago.

One of the very oldest cities of history is Carthage, which was situated on the northern coast of Africa, not far from where Tunis now is. It was destroyed ages ago, and the Romans and other nations plowed up the lands upon which it stood and used them for farms. Within recent years the French, who now control that region, have dug down to where the ancient houses stood, and have found there necklaces, rings, and other ornaments of gold which were worn long ago by the ancient Phœnicians. On the islands of Greece the scientists of our day have dug up golden bracelets, armlets, and anklets which were made by the old Greeks. From the buried city of Pompeii they have taken out all sorts of beautiful jewelry, worn by the Romans who lived in that gay city when it was



Antique Necklaces.

Property of the Metropolitan Museum of Art.

suddenly covered up by the showers of stones and ashes from an eruption of Vesuvius.

From such excavations we learn that the Carthaginian men, women, and children wore rings of gold, and that the girls wore earrings. We know that the Athenian ladies had golden combs to hold up their hair, and that they decorated their necks with strings of pearls. We also read that the Roman men and women had most costly jewels, and that some of them spent fortunes on their personal adornment. Pliny the Elder tells us that the wife of Caius Cæsar, alone, owned jewelry worth what would equal about two million dollars of our money.

Antique Brooch.

Property of the Metropolitan Museum of Art.

Coming down to the Middle Ages, there are many things in history which show us that the knights and ladies of those chivalric days were fond of golden chains, bracelets, and shoe buckles, and that they wore rings set with precious stones. Queen Elizabeth, who lived a little later, had two thousand different dresses in her wardrobe, and many of them were studded with gems. Mary Queen of Scots had a diamond valued at half a million crowns, and Sir Walter Raleigh is said to have worn gems to the amount of thirty thousand dollars in his shoe buckles.

It was the desire for the gold and precious stones, which were supposed to exist in the New World, that caused most of the voyages of discovery made shortly after the

time of Columbus. Sir Walter Raleigh himself fitted out ships to look for an imaginary city called El Dorado, where the king and his court wore clothes sprinkled with gold dust, and had in their kitchens, golden pots and pans studded with diamonds. Sir Walter's expeditions were failures as to the discovery of jewels, but those of the Spaniards, of about the same period, were successes. Cortez found the Mexicans wearing much gold; and Pizarro, who conquered Peru, captured such a great quantity of silver that his soldiers had their horses shod with that metal. He sent back to Spain vast treasures of gold; and when, by treachery, he had captured Atahualpa (ä-tä-wäl′pä), the king of the Incas, the Indians brought in to him as a ransom, enough gold plate and jewelry of various kinds to fill the prison room in which the king was confined, up to a mark on the wall as high as his head.

The first explorers who came to North America found our Indians wearing beads, which they called wampum. They were mostly made of the shells of clams, and were sometimes dyed or stained in bright colors. The Indians used them as necklaces, and also as ornaments for their clothing. They greatly desired the glass beads and buttons which the English and Dutch brought with them to use in trade; and it is said that they sold the Island of Manhattan, upon which New York now stands, to the Dutch settlers for about a peck of such stuff. One of our first glass factories was built at Jamestown, in the year 1607, to make glass beads to sell to the Indians.

During our colonial period the people were poor. Most of them had come to the New World to make their fortunes, and they had no money to spend for gold and silver

jewels, and such other knickknacks. Besides, those who settled in New England were deeply religious, and they looked upon the wearing of jewels as a sign of pride, which all good persons should discourage. Hence there was but little demand for jewelry then, and there were but few jewelers. The business did not really begin until after the Revolutionary War; and it was not until about 1800 that any large jewelry factories were started.

Specimens of modern jewelry.

To-day, making jewelry is one of the chief industries of the United States, employing a capital of many million dollars, and keeping busy tens of thousands of men and women all the year round. Take, for example, finger rings; we produce several millions of them every year; if they could all be put on, side by side, close together, it would require a

finger four miles long to hold them all. We have more than one thousand factories which make jewelry of one kind or another, and their product sells for more than fifty million dollars a year.

A large part of our jewelry is manufactured out of gold and silver, the precious metals being dug from the earth as ore and reduced to bullion before they go to the jeweler's. They come there in the shape of bricks of pure gold and silver, and are again melted and then cast or hammered into shape and polished for use. Both of these metals are soft; and they can be made into all sorts of things with the hammer. They are so valuable, however, that they are often mixed with other and cheaper metals into what are known as alloys, and thus made into jewelry, which is just as bright and beautiful as that composed of the pure metals, but which is harder and more durable, and costs less. Very few ornaments of absolutely pure gold are now manufactured. Such gold is soft, and it wears away easily, and this is an additional reason for mixing a little copper or other base metal with it. The standard metal used for coinage is composed of eleven parts of gold and one of copper, which makes it quite hard. The copper gives the gold a reddish tint. When silver is used, the gold becomes a light yellow, and this alloy is often employed for fine jewelry.

We have a large number of factories that make cheap gold and silverware, some that are devoted entirely to filled work, and some that make jewelry of brass or other metals washed with gold. Much filled jewelry is made at Providence, Rhode Island. In this work, the face of the article is stamped out of a thin ribbon of gold and the

shell filled with a solder of some base metal, the whole being afterwards coated with a thin layer of gold. Earrings, brooches, rings, chains, and watch cases are made in this way. A gold-filled watch case sells for less than one half the cost of one of gold all the way through, and looks just the same. Gold-washed jewelry and imitation gems are manufactured in vast quantities, and are sold everywhere.

For many years the finest jewelry was made in London and Paris, and diamonds were cut chiefly in Holland. Now our jewelers produce as beautiful things as are made anywhere, and our diamond-cutting establishments of New York and other cities are noted for their fine workmanship. We have also many lapidaries; and a great number of precious stones, other than diamonds, gathered from all over the world, are cut and polished by them every year.

36. JEWELRY, SAVAGE AND CIVILIZED

SUPPOSE we take a flying trip over the world to look at the jewelry, which the various peoples now wear. We shall start with the savages. In British East Africa some natives delight in bands of wire wound about the arms from the wrists to the elbows, and about the legs from ankles to knees. They wind the upper arm with this wire, and in some tribes, such as the Masai, the women have great coils of it tied to strings passed through the lobes of their ears. When the railroad which now runs through that country, from the Indian Ocean to Lake

Victoria, was built, the natives stole the telegraph wire in order to use it for necklaces, bracelets, and anklets, and they continued to do so until such thefts were punished with death.

Negro girl, wearing bead necklaces and wire armlets.

Throughout many parts of Africa, wire of copper, brass, and iron is greatly desired for personal adornment, and so much so in some countries that such wire passes for money just as gold and silver do with us. The Zulu children wear little else than beads. In Uganda the natives bore small holes around the rims of the ears and put brass rings in them, and along the coast of the Indian Ocean many have holes about the rims, in which rolls of bright-colored paper are tightly inserted. In other places they enlarge the lobe of the ear, and insert pieces of glass, wood, and metal therein. When the boy or girl is quite young, a little hole is made through the lobe, and a small stick is thrust through. After the sore heals, another stick is added, and then another, until the hole finally grows so big that the child can thrust its fist through it. I have seen women with holes in the lobes of their ears so large that a baseball could easily be put through

"The Zulu children wear little else than beads."

them, and large enough to hold a glass tumbler. This custom is also common in Burma, where girls have plugs of gold, silver, brass, or glass, as big around as one's finger, thrust through the ear. The Burmese are great smokers, and a not uncommon sight there is a woman going along carrying a huge cigar thrust through a hole in her ear.

In the southern parts of our Philippine Islands are tribes who wear shell disks as big as the bottom of a pint cup fastened by a button to the lobe of the ear; and in Borneo, not far away, the women wind thick brass wire about their bodies from the waist to the shoulders, so that at a distance when the sun shines, they seem to be half clad in gold. There are many other savages who wear rings in their noses, and some who have ornaments of shell and bone thrust through their under lips.

The Chinese, whom we have already seen dressed so gorgeously in silks and satins of many bright hues, are fond of jewels. Most of the women have earrings of one kind or another, and many of the men wear thick rings of jade on their fingers and thumbs. The men decorate their caps with bright-colored buttons, and such of the women as delight in long finger nails, often have silver cones or horns to protect them from injury. These cones are three or four inches in length, and they fit over the nails and the end of the fingers much like a thimble.


Masai boy with ear plug of wood.

Crossing from China to India, we shall find the people there often loaded with jewelry. That worn by a single girl of the Himalaya Mountains may weigh many pounds. It is usually of brass, but sometimes of gold and silver. In the valley of the Ganges there are women who wear metal rings in their noses, and some who have silver bells much like sleigh bells fastened to rings about their toes. They remind us of the old nursery rhyme:—

"With rings on her fingers and bells on her toes,
She shall have music wherever she goes."

In all the Indian cities there are men skilled in making things of silver and gold; and it is a common custom there to bring a jeweler to one's home and have him manufacture rings, bracelets, or other ornaments before one's own eyes, furnishing him the precious metals for the purpose. In such cases coins are often used. One pays only for the workmanship, and no two pieces are made just alike.


Indian jewelry.

It was at Delhi in India that one of the most wonderful creations of gold and precious stones ever produced was kept. I refer to the Peacock Throne, upon which Shah Jehan, one of the Indian sultans of the past, sat. The throne cost thirty million dollars, a sum so vast that it is difficult to comprehend it. It was made of solid gold and was reached by steps of solid silver. The back of the throne was in the shape of two peacocks' tails as large as life, and these

tails were composed of diamonds, emeralds, rubies, sapphires, and other precious stones set into the gold, representing the brilliant colors of the feathers as they are in nature.

Some of the finest of the world's jewels are stored away in the government treasuries of the various European countries. Nearly every monarch has magnificent diamonds, rubies, and other gems which have come to him by inheritance or purchase. In the Tower of London is a model of the crown worn by Queen Victoria. It is a velvet cap with an ermine border, covered with diamonds, pearls, sapphires, and emeralds, set in silver and gold. On its top there is a mound of diamonds, and the crown contains all together more than two thousand diamonds and two hundred and seventy-seven pearls.

Many other crown jewels are wonderfully beautiful, comprising some of the great diamonds of the world; and the Florentine diamond, in the imperial treasury of Austria, has been estimated as worth about five hundred thousand dollars. That stone belonged to Charles the Bold, Duke of Burgundy, who lost it while on the battlefield. It was afterwards picked up by a Swiss soldier who thought it a bit of glass, but concluded to carry it along with him as a pocket piece — a sort of lucky stone, as it were. One day he showed it to a priest, who gave him a coin worth less than a dollar for it. The priest sold it to a jeweler for but little more, and from the latter it passed from hand to hand, until it finally came into the possession of an empress of Austria.

I once visited the treasury of the Sultan of Constantinople and had a look at his jewels. They consisted of

diamonds, set and unset, of pearls of all sizes, and precious stones of many kinds. The treasure vaults contained Fez caps with diamond buttons, hairpins with diamond settings, vests covered with jewels, and quilts embroidered with pearls. There were many toys made of jewels with which the baby sultans played, and also a golden cradle in which the babies were probably rocked. The cradle was set with pearls, diamonds, emeralds, and rubies; but I fancy the little ones who lay in it cried now and then, just the same.

37. DIAMONDS

IS it not strange that the most beautiful and most brilliant of all stones should be closely related to those which are most somber and homely? The diamond which, under the rays of the sun, sparkles like fire, giving forth all colors of the rainbow, is the little cousin of the dull lead in our pencils, known as graphite, and of the black coal in our stoves. Graphite, coal, and diamonds all contain carbon, an element which exists in combination with other things in all plants and animals, and in a purer state in diamonds, graphite, and coal than anywhere else.

The diamond is pure carbon. It is found in the form of little crystals widely scattered over the world. In its rough state, it looks much like a bit of glass with regular sides and sharp corners; but, when the sun strikes it at the right angle, it shines like fire. The diamond is the hardest of all minerals. It is often used to cut glass and other stones; and, in cutting and polishing it, other

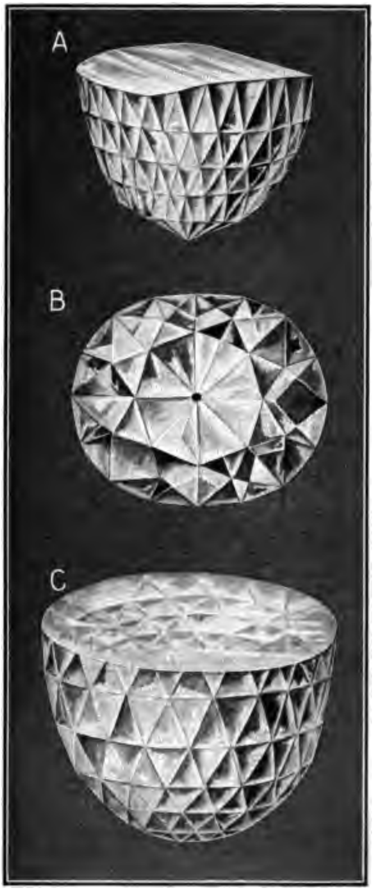
diamonds or diamond dust are the only things that can be used. We shall see how this is done when we visit the great diamond factories.

We usually think of diamonds as white, but they are of many different colors. The most common are white, yellow, and brown; but pure white and fine shades of brown

Cullinan diamond.

and yellow are rare, and they command high prices. The Cullinan (Cül-lin′an) diamond, the largest ever discovered, is white, and so are the Kohinur (ko-ĭ-nōōr′), the Orloff, and the Regent. The Florentine diamond, which was mentioned in the last chapter as found by a soldier on the battlefield, is light yellow, and the Tiffany diamond, a

large and beautiful stone owned by some famous jewelers of New York, is of a deep orange hue. The Czars of Russia had a brilliant red diamond valued highly because of its rarity. The Hope diamond, one of the finest stones ever found, is of a blue color; and in the treasure vaults of Dresden there is a famous pear-shaped diamond which is bright green. Steel-gray diamonds and black diamonds are frequently found, but they are most commonly used for pointing the ends of drills and in other cutting machinery where great hardness is needed.



A, Orloff; B, Kohinur; C, Great Mogul.

The chief use of diamonds, however, is for personal adornment. They have always been sought for as jewels; and they are so carefully treasured that almost all the fine diamonds ever found are still in existence. Nevertheless, the quantity is so limited that if all the diamonds now in use or hidden away in

safes and treasure vaults could be brought together, they would not fill a railroad car.

Most diamonds are small. They range in size from a grain of diamond dust as big as the point of a needle to a few stones as big as a walnut and to one, the largest of all, as big as a man's fist. (They are sold by weight, at so much per carat.) A carat is so light that it takes over one hundred and fifty-one of them to equal an ounce Troy;) so light that a diamond weighing one carat is not as big as the first tooth of your baby sister; and so light that it takes more than thirty hundred of them to equal the weight of the Cullinan diamond, the largest ever found. That greatest of all diamonds weighs just about as much as this book we are reading. It was picked out of the Premier Mine, near Pretoria in South Africa, in 1905. It is three or four times as big as any previously discovered, and looks much like a chunk of transparent ice, being wonderfully pure, clear, and white. It was given by the people of South Africa to the king of England, was split and cut in Amsterdam, and is now in the king's treasure vaults.

Another remarkable diamond, in the royal treasury of England, is the Kohinur, which probably came from one of the rivers of southern India. It was once owned by Shah Jehan, the same man who had the Peacock Throne. It was captured by the English in 1840 and presented to Queen Victoria. The Kohinur is supposed to have weighed seven hundred and ninety-four carats, when it was discovered. It was cut again and again to make it more beautiful, and when it reached England it was not over one third its original size. It now weighs only one hundred and six carats, or a little more than two thirds of an ounce.

The Great Mogul, another famous East Indian diamond which also belonged to Shah Jehan, has been lost or stolen, and no one knows where it now is. For a long time this stone was considered the largest diamond of the world. When first found, it weighed about eight hundred carats, and it was cut to the shape of half an eggshell with many facets. The jeweler who cut it made a little crack in it; and for this he lost all his possessions and came near losing his head.

The Pitt diamond is now the property of the French government, and is kept in the Museum of the Louvre, in Paris. It weighs one hundred and thirty-six carats, and is valued at two and one half million dollars. It was found over two hundred years ago in the gravel of one of the East Indian rivers, by a slave, who concealed it in a hole he cut in his leg for the purpose. He escaped to the coast with it, and offered it to a sea captain on condition that he would take him to a free country. The captain took the jewel, and then threw the poor slave into the sea. The diamond was afterwards sold to Thomas Pitt for about one hundred thousand dollars, and finally came into the royal treasury of France.

The Orloff diamond, one of the Russian crown jewels, is said to have once formed the eye of an idol in an East Indian temple, and to have been stolen by a French soldier who sold it to an English sea captain for about ten thousand dollars. The sea captain sold it to a Jew, and he sold it to Prince Orloff of Russia for more than four hundred thousand dollars. This diamond weighs one hundred and ninety-five carats; it is cut in rose shape, and it looks like half an eggshell with many facets.

The Sancy diamond has a still longer history. It once belonged to the Duke of Burgundy, and was sold by him to the king of Portugal only a few years before Columbus discovered America. Later, it was bought by the Baron de Sancy, who sent it as a present to his sovereign, Henry III of France. The servant who carried it was attacked by robbers; and he swallowed the diamond, which was found in his body after his death. It finally came into the possession of James II of England, who sold it to Louis XIV of France, and thence, after many wanderings, it came to one of the princes of Russia.

Among other famous diamonds is the "Star of the South," which was found in Brazil in 1854. It weighed two hundred and fifty-four carats in the rough, and one hundred and twenty-four after cutting. The "Jubilee" diamond, found in South Africa, and shown at Paris in 1900, weighed two hundred and thirty-nine carats; and another famous stone from the South African mines, "The Victoria," weighed originally four hundred and fifty-seven carats. The Victoria was sold to one of the native rulers of India for two million dollars.

For a long time all the diamonds of the world came from India and Borneo. In India, they were found in rivers not far from the town of Golconda, and were brought there for sale; and in Borneo they came from the western part of the island. Then, in 1727, diamonds were discovered in Brazil, and for one hundred and forty years that country had the principal diamond fields of the world. Finally the mines of South Africa were opened up; and since then the most and the best diamonds have come from that region, although many diamonds are still mined in Brazil.

The diamond fields of Brazil consist of gravel which lies in the beds of the rivers. Some of the best of them are not far from Bahia. The diamonds there are mixed with the stones in the beds of the streams, and to get them the

Washing for diamonds, Brazil.

miners row in canoes out into the river and drive a long pole down into the bed.

They tie their boats to the pole, and then, stripping to the skin, dive down under the water to the bottom. Each diver scrapes the gravel into a big bag which he takes with him. The mouth of the bag is held open by an iron hoop, and as soon as it is full, which takes but a minute, he crawls up the pole to the surface and empties it into the boat. When the boat is filled, it is paddled to the shore, and the gravel is spread out in the sunlight, where the men look for the diamonds. It often takes many bushels of

pebbles to yield a single diamond, and when the mines were at their best, the laborers did well if they discovered one a week. The stones are so valuable, however, that for many years the mines brought in more than a million dollars' worth of them each year.

Outside the chief diamond fields, stray diamonds are occasionally found here and there in other parts of the world. From time to time, more than fifty have been discovered in the United States, and in 1855 one weighing twenty-four carats was picked up near Richmond, Virginia. Since then, others have been found in California and Oregon.

Diamonds have also been discovered in British Guiana, in the Ural Mountains, and in Australia. The greatest diamond fields of all, however, are in South Africa; and we shall now go thither, on one of our flying trips, to see for ourselves how these, the most precious of all stones, are mined.

38. A VISIT TO A DIAMOND MINE

LET us suppose that we have crossed the Atlantic Ocean from New York to Southampton in England, and there taken ships which have carried us down about the west coast of Africa to Cape Town. We shall imagine that, upon landing, we have gone by train many miles northward, through a half desert country, to the town of Kimberley, and are now in a region which contains the principal diamond mines of the world. Since they were discovered, only about forty years ago, more than fifteen tons of precious stones have been taken from them, and they are

producing more than ninety per cent of all the diamonds now mined.

It was at Kimberley that were discovered what might be called the first real mines of diamonds. In India, Brazil, and other countries, as we have seen, these precious stones are so scarce, that comparatively few can be found in one place. They are scattered over the land, or are mixed with the sand and gravel in the beds or banks of rivers; and this was supposed to be the condition in South Africa, for some time after the first diamond was found there. No one imagined that South Africa had diamonds, until one day a hunter, who had stopped to rest over night at the house of a Dutch farmer, on the Vaal River not far from Kimberley, saw some beautiful white pebbles, lying on the table. He picked them up, and his host, seeing that he admired them, told him he might have them if he wished. The hunter said "Thanks," and put them in his pocket. He took them home, and found that one would cut glass. He showed it to a jeweler, who told him it was a diamond and that it was worth twenty five hundred dollars.

When this fact became known, every one round about started out to search for diamonds, and, as the news spread, fortune hunters came in from everywhere. The gravel along the banks of the Vaal and Orange rivers was soon raked over, and quite a number of fine stones were picked up. Then the men began to look for diamonds far and wide over the country near by. They found many on the surface near Kimberley, and dug down into the earth, looking for more. They soon learned that the most and best stones were to be found in certain

places where there was a soft blue rock or clay; and after a time they discovered that the Kimberley region had several great pipes of this blue rock extending far down into the earth. They found that the walls of each pipe were composed of other rocks; and it is now thought that each pipe was formed by a volcanic eruption, in which the molten earth below was forced up through the hard rocks, leaving a hole, which, when the stuff fell back, was filled with this blue clay containing the diamonds.

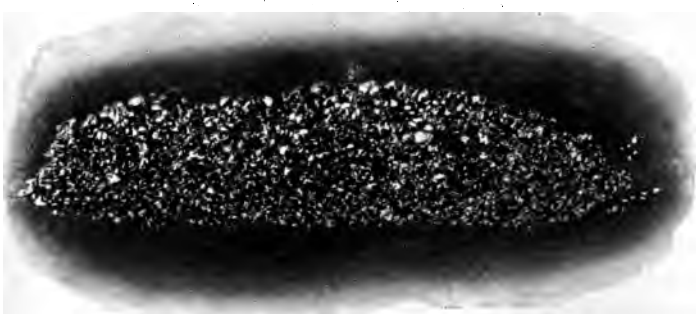
"There are five or six of these mighty pipes about Kimberley."

There are five or six of these mighty pipes about Kimberley, and all are rich in diamonds. Each pipe is well known, and it has now great machinery above it or near it for blasting down the blue rock and carrying it to the surface, and also huge works for washing out the precious stones.

The mines are known as the Kimberley, the De Beers, the Dutoitspan, the Bulfontein, and the Wesselton. They are all being worked and they lie so close to one another

that we could walk around them all in one day. They belong to the De Beers Mining Company, a great diamond trust, that produces more than nine tenths of the rough diamonds found. Its annual product is worth over twenty million dollars, and its mines have already given the world more than five hundred million dollars' worth of these precious stones.

We can see how the diamonds are got out by going through one of the mines. We select the Dutoitspan,



A day's wash of the De Beers Company.

which is the largest of the Kimberley mines. It is a huge pipe of hard rock as big around as a race track, having an area of perhaps thirty acres, filled with this blue rock containing the diamonds. No one knows how far the pipe goes, but the blue rock has been taken out to a depth of hundreds of feet, and diamonds were found in it all the way down. A wide shaft has been dug outside the pipe, and it is by that we descend.

We first change our clothing, and put on heavy shoes with big iron nails in the soles. The mines are wet, and

some parts are always dripping. The rock is rough, and much of it is sharp enough to ruin an ordinary shoe. Accompanied by the manager we step into the elevator, and go down into the earth, passing tunnels which run off here and there. At last we come to the bottom, and start on a long walk through the tunnels from which the diamondiferous earth has been taken.

The work is most carefully done. All the blue ground in the thirty acres must be extracted in order that no diamonds be missed. The earth is blasted down, and carried in cars through tunnels to the shaft, where it is taken up to the top. There are thousands of negroes at work digging out the clay and loading the cars. Ten thousand loads are sent up every day, and an elevator carrying ten tons flies to the surface four times every minute. The men work away day and night all the year through. They burrow through the rocks, cutting out passages from one side to the other, until they have made the whole a maze as intricate as Rosamond's bower. Indeed, there are over thirty miles of tunnels, at the different levels, in this mine alone.

A diamond in the blue ground.

We stay far below ground for a time, watching the

miners, now moving along the car tracks which are lighted with electricity, and now taking candles and making our way over the blue rock, in the new works, just blasted. We look in vain to find diamonds, and the men tell us they may work away for weeks and weeks and not see one stone. In fact, we begin to doubt if there are any diamonds; and we go again to the surface, to learn what is done with the blue clay taken out. It must all be powdered and washed before the precious stones can be found.

The powdering is largely done by the weather. When the rock comes out, it is so hard that one could not easily break it with a hammer; but if it is left in the open, with the rain now and then beating down upon it and the sun roasting it, it will by and by crumble to pieces. In the course of a few months the greater part of it becomes soft, and by twelve months it is almost all powder.

For this purpose the mines have what are called floors for weathering the rock. These each cover eight or ten

On the weathering floors.

acres. They are merely open fields, about which are high fences of boards and barbed wire. Guards march day and night around the fences to see that no one touches the rich earth containing the diamonds, and at night the floors are lighted by electricity.

Both day and night small iron cars, fastened to endless wire ropes, are continually moving to and from these fields. Some of the cars carry the blue stuff to the floors, and others take the weathered rock to the washing machines. The rock is first dumped out on the ground, and then turned over or plowed, that the sun and air may reach all parts of it.

After the rock has been thoroughly weathered, it is carried by machinery to the washing mills. Here it is run through crushers, so made that they will reduce the hard lumps to powder, and at the same time not injure the still harder diamonds within. The rock is sifted after it is crushed, and the coarser pieces are crushed again, until all are soft enough to be turned into mud and gravel by the washers. The powdered rock is now mixed with water and carried over iron tables, known as pulsators, which are slightly inclined and so moved by machinery that the gravel is continually shaken as it goes over them. In this process the mud and dirt are washed away, and the gravel rolls down over the tables.

Formerly, at the end of this work the stones, including the diamonds, were taken out and sorted by hand; but within recent years it has been discovered that if the iron tables, over which the stuff goes, are smeared with grease, the diamonds will catch in the grease, and the other stones will go on. It is in this way that most of the diamonds

are saved, although in many instances the refuse gravel is still sorted, that nothing be lost.

When the tables have been working for some time, the grease is scraped off, and it is only necessary to put the grease and diamonds into a steel bucket pierced with small holes and sink it into boiling water. The heat melts the grease, which rises and floats out at the top, and only the diamonds are left.

It now remains to sort the diamonds and pick them over carefully, in order that they may be graded and valued for the markets. This is done by experts, and in the end the diamonds are arranged in little piles, all those of one kind, and usually those from one mine, being together. They are then sold to diamond buyers, who carry them to Europe or the United States to be cut and polished, before they go to the jewelers who set them for use.

How can they prevent the workmen carrying away the precious stones? A diamond is often worth a vast sum, and a poor negro miner would have enough for the rest of his life if he could steal one and make off with it. For this reason the men are carefully watched. The companies who own the mines will employ only those who will engage to work from four to six months at one time, and to not go outside the mines until the end of the job. After their engagement the miners are guarded day and night. They have houses within great walled inclosures, from which tunnels lead down into the shafts. There are guards outside to see that nothing is thrown over the walls, and the men must buy all their food and other things from the little stores that are kept inside for this purpose. Before a miner is allowed to leave

the works, he is carefully examined to find whether he has not diamonds on him. All his clothes are taken off and the detectives go carefully over his whole body to see that he has nothing concealed anywhere upon it. They open his mouth and examine his teeth; they lift up his arms and pull apart his fingers and toes. They even comb his hair, and if he has any sores on his person you may be sure they will probe them for fear there may be diamonds inside.

Leaving Kimberley, we go northward by train to Pretoria to visit the Premier Diamond Mine, which lies not far from that city. This mine is by far the largest of its kind. It produced the huge Cullinan diamond, of which we have already learned. The mine consists of a pipe of

Diamond washing machine, Premier Mine.

blue ground like those we saw at Kimberley, save that the pipe here is so large that it could contain several of the Kimberley Mines and have room to spare. The Premier pipe is almost half a mile wide, and its precious blue contents cover about eighty acres. It was discovered long after the Kimberley Mines, and has produced quantities of beautiful stones, although the Kimberley people claim that the Premier diamonds are not equal to theirs in purity and brilliancy.

The Cullinan diamond was found late one afternoon. It lay not far from the top of the ground, having been thrown to the surface in the blasting. This was at about sunset, and the last rays of the dying day caught the diamond and made it a blaze of fire. A workman ran to it and carried it to the office. He was given a fine present for being the first to discover it.

Now let us leave South Africa and follow the diamonds on their way to the markets. They are taken to Cape Town by the express trains, and thence on the mail steamers to Europe. We shall find many of them marked for Amsterdam; and it is in that great Dutch city that our next travels are. Amsterdam has for many years been one of the chief diamond-cutting places of the world. Some of these precious stones are cut in New York, London, and Paris, but more in Amsterdam than anywhere else. The work is largely done by Portuguese Jews, who keep at the business from generation to generation.

We have letters from the diamond buyers, and have no trouble in going through one of the factories. It is a drab three-story building of brick, facing a narrow street, and the way up is by wooden stairs no better than those

of an American barn. Everything looks dirty, notwithstanding we are in one of the cleanest of countries, and we can hardly imagine the most beautiful of all jewels coming from such mean surroundings.

The first room we enter is where such diamonds as have flaws are split and trimmed for the polishers. There are a dozen or so workmen, dressed in rough clothing, engaged in the cutting. They are sitting at wooden tables with little boxes of diamonds before them. They take up each diamond, and examine it carefully, splitting it at the flaws with diamond knives.

We have already learned that only a diamond will cut a diamond, and the knife is made by fastening a sharp little diamond, not bigger than the head of a pin, into a bit of cement on the end of a tool like a shoemaker's awl. As the cement hardens, it holds the stone firmly, and the knife is ready for the cutting. The man now fixes the rough diamond in some cement on a similar tool, and then scratches away at the flaw with his diamond knife, until by and by he cuts a little notch there. He now places the rough diamond, which is still in the cement, in a hole in a lead plate, on his table, and then fits a little blade of steel into the notch and taps upon it with a steel bar. This splits the stone, and the two pieces can now be taken out of the cement and ground and polished into the shape desired for jewels.

The grinding and polishing we see done in another part of the works. This is full of machinery which moves about flat wheels of soft iron, as big around as a dinner plate, at the rate of two thousand revolutions a minute. They go so fast that we cannot see them move. The

wheels are covered with a mixture of diamond dust and water, and the diamonds, fastened in cement, as we saw them in the splitting room, are pressed upon the wheel and ground off into the facets, or faces, that so increase their brilliancy. Each wheel has its own grinder working upon it, and the greatest of skill is required to cut just enough and no more.

The polishing is done in much the same way, a long time being required to bring out the beauty and brilliancy of the large and fine stones. In some diamond factories much of the cutting is done by women and girls, who, although they are always working upon these costly jewels, receive wages of but a few dollars a week. The diamond cutters are paid less than two dollars a day, and in the great mines we visited in South Africa, the negroes who dig and blast down the blue ground, receive less than men working on the roads of our country. Is it not strange that diamonds, which sell for so much, should so little reward the people who do the rough work of getting them out and turning them into the jewels we so greatly admire?

39. RUBIES, SAPPHIRES, EMERALDS, AND OTHER GEMS

IN addition to the diamond there are a few other stones so much prized for their beauty that they are sought for all over the world. Rubies and emeralds, which are usually small, often sell for more than diamonds of the same weight, and this is also true of fine specimens of the

Oriental sapphire. Other beautiful stones are the topaz, of a rich yellow hue; the opal that shines like fire when the light strikes it, the blood-red garnet, the violet amethyst, and the turquoise which is as blue as the sky. All these stones may be seen in any of our large jewelry

Ruby mine, Macon County, North Carolina.

stores, and they are often set with gold, in rings, brooches, and necklaces.

We have learned that the diamond is composed of carbon, one of the most common things in nature. It is the cousin of graphite and coal, and is closely related to all kinds of plant and animal life. All the precious stones have their relatives among things which we use or see every day. The same material that shines in the ruby, the sapphire, and in some other Oriental stones is found in the earth of a great part of the world. In the shape of alum it is used for medicine; and as the metal aluminum

we even employ it for tableware and kitchen utensils. When we clean such pots and pans after dinner, we are really rubbing the little cousins of the costly sapphire and ruby. This is also true of the emerald and amethyst and other fine stones, many of which are of the same nature as the quartz rock found everywhere. They have their relatives in the sands of the seashore, and in the glassware we use every day.

It is of the oxide of aluminum, called corundum, that the most precious of the Oriental stones are formed. The corundum crystals of a blue color are the sapphires, and the red ones, the rubies. The yellow crystals are the Oriental topazes, the green the Oriental emeralds, and the violet ones, Oriental amethysts. The word *Oriental* is important in speaking of gems. It means that they come from India or other parts of far-away Asia, and also that they are of a different nature from other stones of somewhat similar names and appearance found in our own country, South America, Europe, and elsewhere. We have beautiful amethysts and rock crystals, composed of silica which is far different from corundum. The finest of emeralds are of the silicate of aluminum, which is by no means the same as the material of the Oriental emerald, which is really a green sapphire. Our topazes are varieties of quartz, while the Oriental topaz is a yellow sapphire and is composed of corundum.

We shall see the corundum gems best by going to southern Asia. The most beautiful sapphires are found in Siam, Burma, and India, from which regions also come the best rubies. They occur in gravelly deposits that are washed and picked over to get out the gems. The

choicest of the rubies come from a little tract of rough land in Burma not far from Mandalay. The mines are owned by an English company which has many natives at work, digging up the gravel and loading it upon cars. The cars carry it to the washing machines, where the clay and sand are churned out, and only the pebbles containing the rubies are left.

As the gravel comes from the washers, it is passed through revolving screens which take out the sand and dirt and sort the stones into grades. They are now ready to be looked over for rubies. The lower grades containing the small stones are given to the natives, and the others which have the large rubies are laid aside to be handled only by trustworthy Englishmen. The latter shake up the gravel in sieves, and as the rubies are heavy, they soon find their way to the bottom. The sieves are now turned upside down on tables, leaving the gravel in piles with the red rubies on top, so that they can be easily picked out by hand.

After the precious stones are thus gathered, they are sorted into about fourteen different grades, and are then shipped off to London for sale. The best rubies are of the clear, bright hue known as the pigeon-blood red; and it is these, when they weigh as much as two carats, that will bring more than a diamond of the same size. Large and fine rubies are scarce. One of the best ever found weighs fifty carats. It is owned by a native ruler of India.

Sapphires are more common than rubies, and some quite large ones have been found. There are several in existence of more than one hundred carats, and an English official

relates that he saw one in Burma which weighed over nine hundred carats, thus exceeding the size of the Kohinur diamond, when first discovered. The best sapphires come from southern Asia, and especially Siam. They are also found in India, Ceylon, Burma, Australia, and elsewhere. Beautiful ones have been picked up in North Carolina; and there is a rocky ledge in Montana which contains both sapphires and garnets. In some years Montana produces many thousand dollars' worth of sapphires, but as a rule its stones are not of large size.

Emeralds have been found in North Carolina; but if we would get the best, we must sail southward across the Caribbean Sea, and enter the Republic of Colombia in the northern part of South America. This precious stone is largely distributed over the globe. It exists in Austria and Russia, and in China on the borders of Siberia. There are emerald mines in the mountainous parts of the Desert of Sahara, and also in Peru. Those of Colombia lie in veins which run through sandstone and slate, and the rock is cut down with pickaxes, and carefully crushed to get the precious stones out.

The emerald has always been admired for its beauty. It is of a brilliant green, and many green things in nature are compared to it. The Irish, for instance, call their country "The Emerald Isle"; a grassy meadow is an emerald field, and when sprinkled with dew it makes one think of an emerald bed sparkling with diamonds. The ancients prized the emerald for its beauty, and likewise because they thought it could heal all diseases of the eye. Nero, the Roman emperor, had an eyeglass made of an emerald, through which he looked down at the men who

fought with the wild beasts in the arena. Pliny tells us of the statue of a lion on the shore of Cyprus that had emerald eyes so bright that they frightened the fishes, and Charles the Great and Napoleon both wore the same emerald ring.

Have you ever heard of the opal? It is a beautiful stone composed of a material like quartz, save that it contains more or less water and gives forth some of the most brilliant colors known. It sometimes looks white and again may be a pale yellow, red, green, or blue. Fire opals shine like fire when the light strikes them, and show almost all the colors of the rainbow. The ancients considered the opal the luckiest of all lucky stones. And in the far East it is believed that its wearer will be favored by heaven and loved by all upon earth as long as he has faith in its power. In our country some believe that the stone will bring bad luck to the wearer, but I doubt whether any boy or girl of our party would refuse the gift of an opal for such reasons.

The opal is found in Mexico and Honduras and also in South America. It occurs in the Carpathian Mountains in Europe, and there are large opal mines in eastern Australia. Some have also been discovered in certain of our Western States. About the finest specimens, however, are from the Carpathians, the most beautiful opal ever found coming from there. This stone, one of the famous jewels of the Austrian crown, is of about the size of a man's hand, and it weighs seventeen ounces. Opals are usually embedded in other stones. They have a different form from the diamond, sapphire, or ruby, and are usually round or oval in shape.

In addition to the stones we have already seen are many

less precious, which are largely used in jewelry of one kind or other. The blue turquoise is prized among the Mohammedan people, and characters from the Koran are sometimes carved upon it. It is found in parts of Asia and Europe and also in Arizona and others of our Southwestern States.

Jade jewelry.

Property of the Metropolitan Museum of Art.

In China, jade stones are highly prized; and they are made into rings, bracelets, buttons, and earrings. Jade varies in color from white to dark green, and it takes a polish like onyx. It is found in Burma and in some other parts of Asia. It lies in veins, running through rocks. Some streams have jade pebbles and bowlders, which are known as water jade; they are much prized by the Chinese.

Jade bracelet.

Property of the Metropolitan Museum of Art.

A very common gem is the garnet, which is somewhat like the ruby in color, but by no

means so beautiful. Another is the amethyst, a purple variety of quartz, used as settings for rings, bracelets, and necklaces. Both of these stones are common to many parts of the world. We have fine amethysts in Pennsylvania, Maine, North Carolina, and along Lake Superior; and they are also found in Brazil, Ceylon, and the Ural Mountains. Beautiful garnets are mined in Bohemia and at Kimberley in South Africa, where they are mixed with the diamonds. We have fine garnets in Arizona, Colorado, and New Mexico, and many common ones in New York, Pennsylvania, and Massachusetts. In the latter States, garnets are mined to be used for polishing and cutting other stones, and many tons of them are ground up for making sandpaper. They are also employed for pivots in watch movements, something like seven million of these little stones being so used in the United States every year.

40. PEARLS

IS it not strange that one of the most beautiful of jewels should come from an oyster? The pearl is found in the body of the pearl oyster. It is not in every

Pearls in the shell.

oyster, but only in an occasional one. It is supposed to be caused by a grain of sand or some other irritating substance getting inside the shell. This hurts and annoys the oyster, and, to protect itself, it coats the offending particle with layer after layer of material similar to that of which it makes its shell, until it finally builds up the beautiful round or irregular object we know as the pearl. It is so smooth that it does not hurt the oyster, which lives on as though perfect throughout. The material used is carbonate of lime, the same as is found in whitewash or mortar, so that the walls about us and often the ceiling overhead are composed of the little cousins of the pearl.

Pearls have always been highly prized, and to-day the finest are worth as much as precious stones of the same size. The Bible refers again and again to the pearl as a thing of great price, and it was one of the most costly jewels of the ancient world.

Pearls were used in East India, long ago, for decorating the Hindu idols; and when the Spaniards conquered Mexico they found the palaces of Montezuma, the Aztec king, studded with some which probably came from the Bay of Panama. To-day there are beautiful pearls among the crown jewels of Europe, and many are owned and worn in our own country.

Pearls are usually of a satiny silver or of a bluish white color; but are sometimes pink, purple, yellow, gray, smoke-brown, and black. The finest white ones come from about Ceylon and in the Persian Gulf; and also from near Thursday Island and off the west coast of Australia. They exist in the Red Sea and in the waters of our Sulu Islands. Yellow pearls are found in the Bay of Panama,

and the finest black and gray ones off the west coast of Mexico and in the Gulf of California. We get pink pearls from the conch shells of the West Indies, and also from our fresh-water mussels, while purple, light blue, and black ones are made by the common clam. The value of pearls depends upon their size and perfection of form, and their luster and purity of color. They are sold by the pearl grain, of which it takes four to equal one carat, and over six thousand to make an ounce Troy.

The jewels of an Indian prince.

The Maharaja of Patiála, wearing necklace of pearls, a scarlet velvet cloak embroidered with pearls valued at more than a million dollars. The turban is decorated with ropes of lárge diamonds.

We find beautiful fresh-water pearls in the mussels of many of our rivers and creeks, some of them being worth as much as a thousand dollars or more. The finest of all pearls and those which have been most prized as jewels are from the warm waters of the Indian Ocean,

and of the southern Pacific, about northeastern Australia, and the waters between New Guinea and the Sunda Islands.

Suppose we make a visit to some of the chief pearl fishing grounds. We take steamers at New York, and in eight days are at the Strait of Gibraltar. Three or four days more carry us across the Mediterranean Sea and through the Suez Canal into the Red Sea. Fine pearls are found here in the shallow waters between two barren islands not far north of the Strait of Bab-el-Mandeb, and we stop at them before going to the great pearl fisheries of the Persian Gulf and Ceylon. The diving is done by natives, who believe that the pearl is born in a drop of rain that falls into the mouth of an oyster and straightway turns into a pearl. They tell us that pearls come also from the tears of angels, who are weeping over the sins of man, and that the oysters catch them as they fall.

Going on down into the Indian Ocean, we steam around the south coast of Arabia and enter the Persian Gulf. We then sail up its west coast a short distance, and come to anchor in the little Gulf of Bahrein (bä-rān′) at the islands of that name. We are now on one of the world's chief pearl oyster beds. For ages out of these waters have come vast treasures, and the value of the pearls now found every year amounts to more than one million dollars. From June until October hundreds of boats are always out fishing for pearls, and there are thousands of fishermen who do nothing else. The islands are almost a desert, save where a few springs give water enough to irrigate small tracts. Their only inhabitants are Arab and Hindu merchants, who own most of the craft and outfit the divers,

keeping them so much in debt that they are practically slaves.

The men go out in their boats, taking supplies of food and fresh water, and remain as long as these last, which is sometimes for weeks. They go to where the oyster beds lie, sixty feet or more under the sea, and anchor there while they dive down and gather the shells. They work almost naked. Each has on his nose, to keep out the water, a sort of a clothespin-clasp, made of two thin slices of horn nailed together; and long thimbles of leather to protect his fingers while tearing the sharp, rough shells from the bottom. He has a network basket to hold the shells; and a huge stone is tied to his feet to aid him in sinking. This is pulled up as soon as he reaches the bottom. He has also a rope by which he signals to the boat, when his basket is full, or if he wants to be drawn up on account of some danger. A diver can remain under the water only two or three minutes at one time. The pressure, so far down, is great, and it sometimes makes the men deaf or unconscious. Moreover, there are sharks and devilfish which often attack them.

When the oysters are brought up, they are left on deck overnight. The next morning they are opened and looked over for pearls, the shells being saved for export. We watch the boats as they land, and go with the merchants to examine the pearls just found. They are of all sizes, from little seeds, no bigger than grains of sand, to some as big as peas. One pearl is as large as a hazelnut. Some of them are round, some oval, some flat, and some are shaped like buttons. As we look, the dark-faced brokers, dressed in turbans and gowns, gather around us

Pearls of various shapes.

and show us their precious wares, which they carry about with them in bags of turkey-red calico. We ask the prices, and a merchant takes out a pair of little brass scales and weighs each pearl, fixing its value according to its size, beauty, and weight. We offer less, and after long bargaining get several beauties at what our guides say is about what they are worth.

The finest and largest of the Persian Gulf pearls go to Europe, the irregular ones to India, and the most of the seed pearls to China.

Sailing back into the Indian Ocean, our next stop is off the coast of Ceylon, about a night's ride by boat from the port of Colombo, where there are pearl fisheries that bring in five hundred thousand dollars or more every year. Here the diving is done by Arabs, the oysters being brought to the shore and left there to rot, when they are washed out for pearls. In the Sulu Seas our Moro divers gather pearls in a similar way, but their product does not compare with that of the Indian Ocean.

Leaving Ceylon our steamer takes us to Singapore, from

where we cross the equator, and go on eastward a little south of that line through the Dutch East Indies to Torres Strait, which flows between New Guinea and the end of northeastern Australia. We land at Thursday Island, just about halfway through the Strait, and in the midst of one of the world's chief pearl fishing grounds. The sea here is studded with islands, named after every day of the week. We pass Sunday Island, Monday Island, and Tuesday Island; and are told that Friday Island is over the way. To the northward is New Guinea, the third largest island of the world, and farther eastward are countless islets shining like emeralds in the sapphire sea.

Many of these little islands are of coral formation. They have low shores, with shallow bays and lagoons where the quiet waters have just the conditions most liked by the pearl oyster. These beings do not like sand, and they will not thrive where the tide moves the water about. They differ much from our oysters, which range in size from the diameter of a cent or less to that of one's hand. They are great fellows, with shells which are sometimes larger around than a dinner plate, and weigh two or three pounds. The pearl oysters lie at the bottom of the sea, and they also fasten themselves to the coral rocks. They are fond of coral formations, and when they can attach themselves to them, grow to great size. The fastening by which they are held is a muscle that extends out from the hinge of the shell; and that must be cut before the diver can take them away.

Here at Thursday Island, the fishing is done by the natives of New Guinea and the islands about, and also by Japanese, Chinese, and others. They go out in sailboats,

each of which has a pumping arrangement to force air down to the fishermen as they work away in the oyster beds under the ocean. The men clothe themselves in thick flannels, and then put on diving suits, to which air pipes are attached. The suits have bonnets or heads of metal with glass fronts, so that the divers can see out.

Pearling lugger, with diver.

They have boots soled with heavy plates of lead, to enable the men to sink to the bottom. Each boot weighs twenty-eight pounds. In going down, the diver is careful to keep his feet below him; for, if he should lose his balance or permit his boots to fall off, he might find himself head down with his legs pointing to the surface. If one boot drops, the foot on which it was may fly up. He must keep his weight under him; and when he picks up a shell

from the bottom, he carefully straddles it and reaches down. When the diver signals, he is quickly drawn up. There are many sharks and poisonous fish and also the great squid that emits an inky fluid which so discolors the water, that the diver cannot see and is liable to fall against the sharp coral rocks.

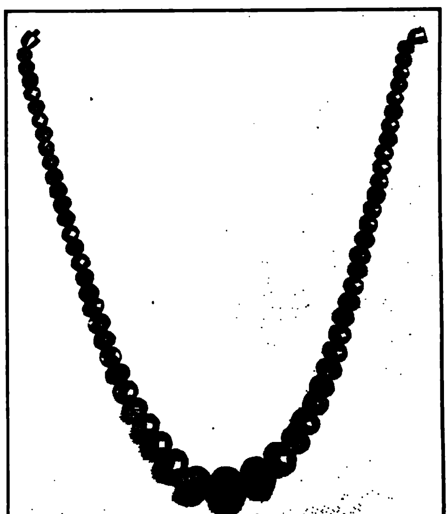
For fear of such things the man works as quickly as possible. He gathers the shells in his net basket, and when it is full, pulls his signal line to be hauled to the top. He now waits a short time and then goes down again, often making a number of trips the same day. The shells are afterward opened with a thin-bladed knife much like a common table knife. The oysters are cut out and carefully examined for pearls, and then thrown away. The shells are all saved, and are exported to Europe and other countries to be used in making knife handles, buttons, brooches, buckles, and other such things. Indeed, while the pearls found are of great value, the shells themselves are worth even more; for the pearls are few in number, and the shells are many. One of the chief markets for them is London, where the best will sell for five hundred dollars and upwards a ton.

In addition to pearls, there are several valuable products of the sea which man wears in one shape or another. We use the bone of the jaw of the whales of the Arctic and Antarctic oceans, to stiffen our dresses; and the shell of a tortoise of the semitropical seas for combs, hairpins, and brooches. From the coral beds of the Mediterranean we have beautiful red, pink, and white beads, and from the sands of the Baltic comes the most transparent of the yellow amber prized so highly for necklaces. Coral is made by

Amber.

the coral polyp, a little being that lives in many parts of the ocean. It is fished for by dropping huge wooden crosses down into the coral beds, and thus breaking off pieces into the nets which the fishermen sink for the purpose.

Amber is a fossilized resin, of vegetable growth. It is really the gum of a tree, which has become almost as hard as stone by the action of the elements. It lies in a great layer along the Baltic coast, and is often washed up by the waves. The fishermen dive for it, and poke about through the weeds, on the bottom of the sea, in the shallow waters near the shore to find the choice lumps. The



Amber necklace.

palest of the straw-colored amber is used for the mouthpieces of tobacco pipes and for jewelry, and the rich yellow lumps are in great demand for beads, especially among the dusky beauties of certain tribes of North Africa.

41. BUTTONS

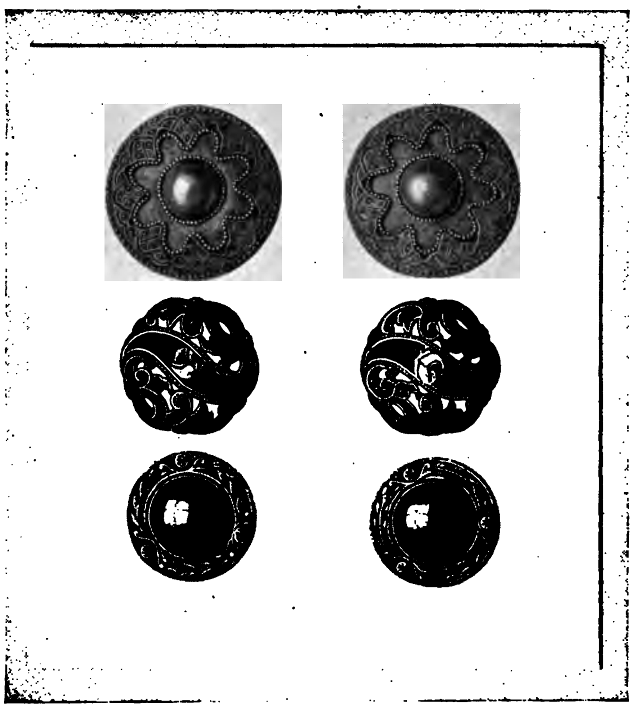
BUTTONS are often used as examples of things of small value. Nevertheless, they are most important in the world of clothing. Suppose all the buttons of all mankind should refuse to work. Nay, suppose they should leave their jobs and go on a strike. What a commotion they would create. Every man, woman, and child of us would run for his bed chamber, and there would not be enough blankets to cover us all.

Still, the use of buttons on articles of dress is comparatively recent. The savages all over the world employ strings to hold their clothing together. The Greeks and Romans had girdles or belts, and it was not until the Middle Ages, or later, that the button appeared. It was first used as an ornament, and was fastened to a loop, the buttonhole coming in later.

The trade of button making dates back to the days of Queen Elizabeth. At that time these little articles first became important as clothes fasteners, and Dame Fashion, finding that she could make them ornamental as well as useful, aided the business by employing them largely in clothes decoration. During the fifteenth century, men wore coats loaded with gilt buttons; the army and other

officials adopted them as parts of their uniforms, and they then took their place as one of the chief ornaments of women's fine dresses.

Buttons were already common during our colonial era, and as early as 1750 Philadelphia was making buttons of



Ornamental buttons.

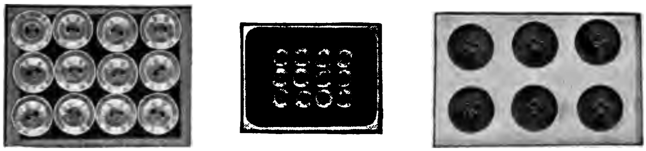
brass and a little later of wood. About fifty years after that a factory was built at Waterbury, Connecticut, which cast buttons of tin and pewter; and now we have many establishments, scattered over the United States, manu-

facturing them from all sorts of curious materials. We have many buttons of metal, and of hoofs, horns, and bones, the last including ivory from elephants' tusks. We have buttons of pearl shells and mussel shells, of vegetable ivory and vegetable gums, of porcelain and glass, and of all sorts of materials in composition. We make buttons of blood, of paper, cloth, skimmed milk, seaweed, and even of the Irish potato, which, when mixed with certain acids, becomes as hard as a stone. The campaign buttons, bearing the photographs of candidates, are usually made of celluloid, and the finest pearl buttons come from the shells of pearl oysters, such as we saw taken from the sea near Thursday Island.

Our government has given patents for several hundred different kinds of button-making machines, and in a half-dozen or more States, button making is an important industry. Pennsylvania is famous for its bone buttons, New York and Connecticut for their brass buttons, and Massachusetts for buttons covered with cloth. Iowa and Illinois make fresh-water pearl-button blanks, and Iowa, New York, and Pennsylvania fresh-water pearl buttons. New Hampshire makes buttons of paper, New Jersey of tin, and Connecticut of horn. New York, New Jersey, and Pennsylvania manufacture many from the shells of pearl oysters, and Massachusetts, New Jersey, and New York have a large product from vegetable ivory. The buttons our factories make yearly, sell for some millions of dollars, and those we import from Europe cost several millions more.

Before we start out to visit the places where buttons are manufactured, let us take up a handful or so and look at their shapes. They are of all kinds and sizes, and of as

many different materials as we have already mentioned; but they may be divided into three general classes, according to how they are sewed on our clothing. Take this big flat cloak button of pearl shell, and the little horn trousers button beside it. Each has four holes bored through its



Buttons of shell and of bone.

center for the thread that, sewed through the cloth and over and over the button, fastens it on. Here is a coat button made of rubber, that has only two holes, and we find many other kinds pierced the same way. They all

Metal buttons.

Cloth buttons.

belong to the first class, being sewed on through these holes in the button itself.

Now let us sort out all of this kind from our collection, and see what we have left. We have metal buttons with shanks on their under sides, the shanks being little round rings through which the thread goes to sew them tight on.

We have buttons of bone, glass, and vegetable ivory made the same way, and buttons of all sizes from great ones for overcoats to the little round black fellows we use on our shoes. This is the second class.

In addition to these, we have other buttons in our collection which have a tuft or layer of felt or cloth on their under sides, in place of the shank. The needle is run through the cloth tuft, and the button is fastened by means of it to the garment. Many of the buttons of this kind are covered on the outside with cloth, or they may be of metal or pearl or some other material with cloth fastened on to the back. This is the third and last class. Almost all buttons are formed in one of these three ways, and machinery of many kinds has been invented to make them in vast quantities and at a low price.

Buttons are of so many materials that we shall not have time to trace them all back to the places from where they come. We have already seen the pearl divers getting out the shells of the pearl oyster in the Persian Gulf and off North Australia; and we know that they are collected by the thousands of tons for making fine buttons. In our Western rivers and creeks, mussel shells are gathered for the same purpose. There is a section of the Mississippi Valley, two hundred miles long, where these shells are found in great quantities, and in one year as many as three hundred million buttons have been made from them. There are factories where the shells are either made into buttons or into round blanks which are sent to the button-making establishments of the East to be bored and polished and finished for use. These shells are small and dark in color on the outside. They are gathered in boats by men

and boys who work even in the coldest weather, at getting the shells from under the ice. They cook the mussels to extract the meat, and sell the shells by the pound.

After the shells come to the factories, they are sorted into three different sizes. They are next soaked in water for several days to soften them and are then sawed by machines into blanks. The saws are hollow tubes of steel, about as long as one's little finger, and as big around as the buttons which are to be made. One end of the tube is filed into many fine teeth, and as this tube, fastened in a lathe, revolves, the teeth cut out the blanks from the shells pressed against them.

After this the backs of the blanks are ground upon emery wheels to take off the skin, and give them an even surface. They are next turned or ground into shape by other machines, and then the holes are drilled through the center. Now comes the polishing that gives back the luster, lost in the grinding, which forms their chief value. This is done by placing some thousands of blanks in a large wooden keg which is rolled round by machinery. A chemical mixture is put into the keg, and by the wearing of one button against another, they finally come out as bright and shining as was the inside of the shell as nature polished it. The buttons now go to the sorting room to be arranged in sizes and sewed upon cards. They are then packed in pasteboard boxes and shipped off for sale. These buttons are so largely used that our supply of shells is fast becoming exhausted.

It is in this same way that almost all buttons with holes, made of shell, bone, wood, or ivory, are cut out and drilled. When the buttons are of metal, the holes are often punched,

and then made smooth, so that the sharp edges may not cut the thread.

Many of our metal buttons have shanks at the back, and the same is true of those made of glass, porcelain, ivory, and shell. The best metal buttons are formed by stamping circular disks out of sheets of brass or other metal. They are then pressed into shape, and are ready for the loops or rings called shanks, which hold the thread. These are made of wire in another machine which cuts off just the right lengths, a shank being soldered to the back of each disk. After this the buttons are dressed on a lathe, and gilded and burnished, or sometimes lacquered or varnished, as we see them for sale in our stores.

If we could follow the manufacture of ivory buttons, we should have to start by hunting the elephants of the African wilds, and then go with their tusks to the great markets at Antwerp or London. These buttons are so costly, however, that their place in commerce is small, and the trip would not pay. Moreover, they are made in about the same way as other buttons, having holes and shanks.

It is different with buttons of vegetable ivory. This looks like true ivory, but it is so soft that it can be turned in the lathes, and be easily dyed. Vegetable ivory comes from the nuts of certain low trees found in South America. The nut is about as big as the fist of a baby, and as hard as stone. It grows inside a bur not unlike a chestnut bur and as large as one's head, each bur containing one dozen or more. The nuts are gathered by the natives, and shipped in great quantities to our country and Europe for the making of buttons. When they arrive at

the factories, the shells are first taken off, and the kernels are then divided into the halves out of which the buttons are bored, or into blocks from which they are shaped by machines. After dyeing they are dried in wire trays. They are then polished by machinery, by rolling them about in a felt-lined barrel, or in other ways, by hand.

Horn buttons should be called hoof buttons; for most of them are made of the hoofs of cattle bought of the meat packers for this purpose. The hoofs are boiled in water until they are soft, and then cut into strips with a long-handled knife. The strips are divided into small squares, each large enough for one button, after which the corners are taken off, making the blanks octagonal in shape. They are now dyed and dried, when they are ready to have the fasteners stamped on. This is done in a press by means of hot molds or disks. After this the buttons are clipped and made round and smooth.

The manufacture of cloth buttons is even more complicated, and the processes of making gilt and gold buttons are many, although in general much the same as those of the metal buttons already described.

42. PINS

AT about the time our Revolutionary War broke out, when England was oppressing the American colonies, and our forefathers were doing without tea and many other things rather than pay the taxes upon them, pins were among the articles which caused them the most trouble. During that period all our pins were imported

from Europe, and our great-great-grandmothers found it difficult to get along without them.

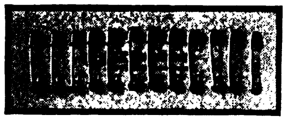
It was about 1776, that a boy, wandering over the hills on the banks of the Hudson River, not far from the little city of New York, filled his pockets with the thorns from the bushes which grew there, and ran home with them. As he came in, his mother was talking with a smooth-shaven, distinguished-looking man who was rather plainly dressed, and when he slipped the thorns into her hands, the man asked what they were. "Pins," replied the boy. "They are long thorns which I found on the hills, and we use them to fasten our clothes."

"Give me some," said the man. "I am on my way to France. I will take them with me, and I will show that a nation that grows its own pins can never be conquered."

That man was the great Benjamin Franklin, who had come to see the boy's father before leaving New York on his mission to represent the New Republic in France. What he did with the thorns, history does not tell, but we know that he soon convinced the French that we were able to support a government of our own, for they were among the first of the foreign nations to recognize our independence of England.

From this story we get an inkling of the history of pins and also an idea of their value to us. The first pins were probably thorns or fish bones or splints of wood. Then men learned how to cut pins from bone, and hammer them out of the softer kinds of metal. In the ruins of the lake dwellers of central Europe, men who lived before history

began to be written, thousands of bone and bronze pins have been discovered. Bronze pins have been found, also, on the mummies of Egypt, and the old Greeks had some beautifully decorated. When Pompeii was unearthed, hair-pins of bone and bronze were mixed with the ashes, and we know that the Romans made some beautiful pins. At about the time of Columbus, the English began to make pins of iron wire, and in 1826 they had some of brass.



Safety pins.

The pins sent to the colonies were probably of iron. They were made with but little machinery, and thirteen or fourteen men worked on each pin. The point was filed sharp, and a piece of fine wire was twisted around the end as a head. At that period and for years thereafter, pins were things of some value; and so much so during our War of 1812, when they became scarce and it was difficult to import them, that they often brought as much as one dollar a package.

It was at about that time that some men came to our country from England and started pin making here. Later on, various inventions were discovered for putting solid heads on the pins, and still later for manufacturing the pin, head and all, without the aid of the hand. Now a reel of wire goes into a machine and comes

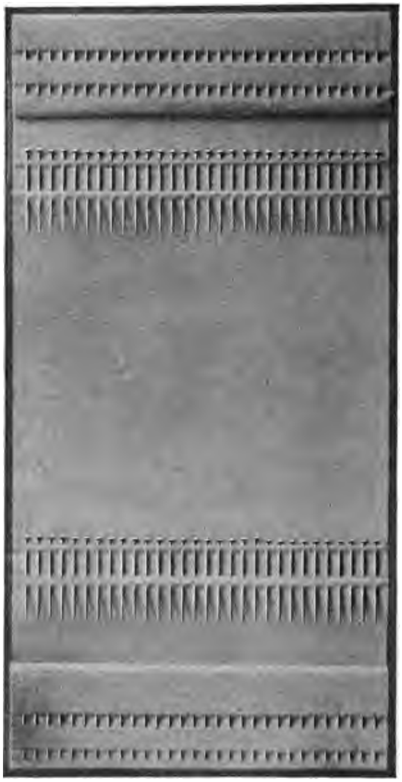
out in pins, sharpened and headed and almost ready for use.

Moreover, the cost of making pins has been so cheapened by machinery, that the prices have steadily fallen, and these necessary little articles are now amongst the cheapest of the things sold in our stores. A few centuries ago it was only the rich who could afford many of them. A great pin industry has grown up, both in our own country and Europe, and they are now turned out by the billion. Not long since Great Britain and France were making several hundred millions every week, and we have some establishments which turn out millions per day.

When our last census was taken, we had in the United States about fifty factories which were then making over seventy-two hundred million pins every year. The number is so enormous we cannot conceive it; but if we suppose each pin to be one inch in length, and that all were laid end to end, the line of pins would be six or seven hundred million feet, or over one hundred and twenty thousand miles long, which is about half the distance from the earth to the moon. We make enough pins to allow each of us more than one hundred a year, and leave millions to spare, and so many that our annual production sells for a million dollars or more.

In a model pin factory, the metal begins its travels in the shape of fine wire of the thickness of the pins which are to be made. The wire is first drawn through steel rollers or over a straightening board, to take out the curves, bends, and kinks; and it is then fed to a machine which turns it into pins. As the wire goes through, it is cut into pin lengths, and at the same time one end is left

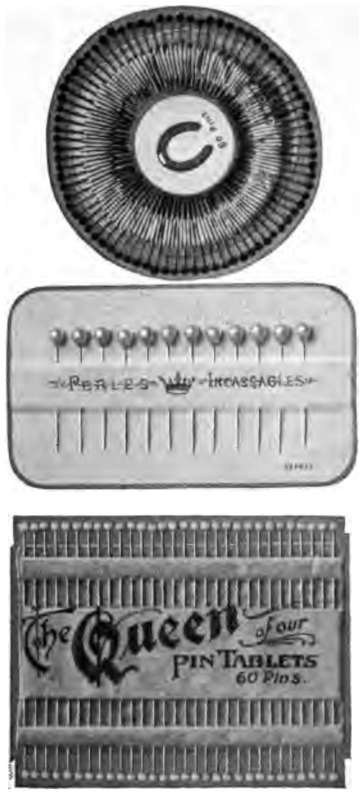
sticking out of the jaws of the machine. This is struck by a piece of steel so shaped that it forms the head; and the pin blanks, thus headed, go on into a tray and drop down through a slit. The slit is just wide enough to hold the stems of the pins, and they hang by their heads. In this position the lower ends are filed off by machinery which rubs and scrubs them into fine points, and then pushes them onward to make way for others.



A paper of pins.

The pins have now been shaped, headed, and sharpened. They are still of a dull color, and have to be coated with tin and cleaned and polished before they are ready for sale. In some factories they are first boiled in a weak beer, which takes off the grease and dirt. They are then cooked in an odd way in great vessels of copper in a solution of tin. In this process, a layer of tin grains is placed on the bottom of the vessel and then a layer of pins. Above this comes another layer of tin and then

another of pins, and so on until some thousands of pins are thus put away in their little tin beds. Over the whole, water is poured, and some cream of tartar or like chemical added. The vessel is then placed on the fire, and as it cooks the acid in the chemical goes into the water, and forms a mixture into which the tin grains melt like so much salt or sugar. After a while all the tin has gone into the acid water, and it has become a solution of tin that sticks to the pins so that they come out covered with it. The pins are now washed in clean water and then shaken together by machinery with bran, until every one of them shines like new tin when freshly scoured.



Hand-made pins.

They are now in the shape that we use them, and have only to be stuck in the papers to be ready for sale. The papering, as this is called, is largely done by young girls who sit before tables, upon which the pins fall down from a hopper above. As they drop they pass through slits in

a steel plate, where they are suspended by their heads. In this plate they are so arranged that they go right through certain long, narrow sheets of paper which are fed by machinery, and come out stuck in just the right order, the papers being cut and folded in the shapes that we find them when sold.

Safety pins are made in much the same way, save that no heads are put on and the wire is bent into shape. Pins with glass heads are made largely by hand. A glass rod of about the thickness of the head, is melted in a gas jet; and while it is soft, the workman thrusts in the stem, and by a whirling motion takes off and forms the glass drop which makes the head. It is said that one man can head twenty-five thousand pins in one day.

43. NEEDLES. THE SEWING MACHINE

OUR travels are now to be along the life pathway of the needle, whom we might call the pin's sharp little sister. This young lady is one of man's best workers in the great world of clothing. She is present in one form or another at the making of every garment, her bright little eye pierces all parts of it, and she pokes her sharp tongue in everywhere. She is a busybody; and is always running in and out, dragging the thread which ties the pieces together. When all is secure, she trots off somewhere else, and leaves scarcely a track on the seams which were the paths of her travels.

And still, it was a long time before man was able to secure this valuable servant. He early discovered the

need of some such things as needles, but it took ages for him to find out how to make the shining steel ones we now use. He first experimented with thorns and bones, making something much like an awl, to pierce holes in the skins

Sewing machine.

which formed his clothing; and then passing the long fibers of plants or thin strips of leather through to bind the pieces together. Later on, needles of stone or bronze were made, and a rude eye was bored at one end. Bone needles with eyes have been found in some old caves of France, and also in the ruins of the lake dwellers of central Europe. We have also taken bronze and bone needles out of the Egyptian tombs, and similar needles were discovered in the ruins of ancient Greece and Pompeii.

It is supposed that the first steel needles were made by the Chinese, who were sewing with them when America was still undiscovered, long before they were used in Europe. Chinese needles are believed to have been brought into Europe by the Moors in the Middle Ages; and it was shortly after that that the Germans copied them and our ancestors began to have steel needles of their own.

During the reign of Queen Elizabeth, needles were sold

at the small shops of London; and it was soon afterwards that the English began to manufacture them. To-day England makes more needles for hand sewing than any other country, and that country and Germany produce the greater part of the hand needles used by the world. As to the needles employed in sewing machines of various kinds, they are more largely manufactured in the United States than anywhere else. We make hundreds of millions of them every year, and our product annually sells for more than one million dollars. At the same time we produce very few of the needles we use for hand sewing, annually importing hundreds of millions of them from England and Germany.

Needles are made of steel wire. In the common sewing needle the wire is first wound in a coil, which is cut by machinery into lengths of just the right size to make two needles each. The coiling of the wire curves it a little, and it must be made perfectly straight before the work can go on. For this purpose the little pieces are collected into bundles and placed in two iron rings which hold them loosely together. They are now heated slightly and then rolled over and over on a flat iron plate. The action of the wires upon each other tends to straighten them, and after a time the curve is all taken out, and the bits of wires are as straight as the needles sold in our stores.

The next operation is pointing or grinding the blunt ends to the exquisite sharpness required. This was once done by hand, but it is now performed at the rate of forty thousand an hour by means of a little machine that the Germans have invented. This is a metal wheel upon

which the blunt wires drop from an inclined tray, and are held fast by an India rubber band that runs around the wheel. They lie in such a way on the wheel that the two ends of the wires just touch a hollow grindstone placed near it, and so that each end is made sharp as the wheel flies around.

The double needle wires are now ready for their eyes. The process of making these is important, for, if roughly

Assembling room in a sewing machine shop.

done, the thread will be cut and frayed as it goes through. The work begins in what is called the stamping room. The double needles, pointed at each end, are placed upon a solid block, to which is fastened a mass of iron. On the upper side of this moves the under half of the stamp which cuts the groove for the eye of the needle. The upper half of the stamp is fastened to a heavy hammer, and when worked by machinery, it falls down upon the

needles with such force that the grooves or depressions for the eyes are made.

The wires now go to the piercers, who are usually small boys working at hand presses. The little fellows must have good eyes and skillful fingers; it is said that the best of them can punch a hole through a human hair. These boys first spread out the wires upon an iron slab, laying them under the press in the form of a fan. They then punch wire after wire, making two eyes each time. The wires are now taken out and so arranged that the roughness in the eyes may be filed smooth. After this each wire is divided between the eyes, making two needles. The heads are then filed into shape.

But the needles are not yet ready for use. They must be hardened, tempered, polished, and brightened before they can be stuck in the papers and packed up for sale. The first process is performed by baking them in a furnace until they are white hot; and then cooling them in a bath of water and oil. They are then washed and dried and tempered by slightly heating them once more. The polishing is done by putting them in bags with a mixture of soft soap, oil, emery, and sand; and then rolling the bags over and over between heavy slabs, weighted with iron, until at the end they come out smooth and bright. They are next shaken up in a sieve to separate them from the dirt, and are then further smoothed and polished. Altogether, every needle has to go through many hands, and it takes quite a long time to make one.

Machine needles are made after similar methods, save that the eye is punched through the point instead of the end; and that there are American inventions for cer-

tain of the processes which enable us to make them rapidly and at a low cost.

As to the sewing machine itself, the world owes that largely to Americans. Our people have invented the most important things connected with it, and we are now making more sewing machines than any other nation. We make all we use ourselves, and we annually ship many thousands abroad. A great deal of money is devoted to the industry, and our machines bring in a large sum.

There are many kinds of sewing machines, and they have come into almost universal use as far as civilized man is concerned. Nearly every family in the United States owns one or more; and we have hundreds of factories and other establishments in which such machines, invented for special work, are to be seen. They are largely used for shoemaking, employing many thousands of hands and enabling us to produce several hundred million pairs of shoes every year. We find them in our shirt factories, where more than thirty thousand girls are always stitching away to their song. They are used by our tailors, dressmakers, and milliners, and by bookbinders and saddlers. We have special machines which sew on buttons, and many of our household machines have attachments for making buttonholes. Sewing machines are employed in seventeen different industries, and they will do almost every kind of work in making clothing.

We have to-day two types of household sewing machines, according to the stitch used by them. One has a double thread, and makes a lock stitch; while the other employs either a single or a double thread and what is called a chain stitch. The lock stitch resembles weaving, and the

chain stitch is rather like knitting. At the time of our last census, nine out of every ten of our household sewing machines used the lock stitch, although some people will tell you they much prefer the chain-stitch machine.

The first sewing machine was invented by an Englishman more than one hundred and fifty years ago. It was merely for hand embroidery and was of no value for plain sewing. Others of various kinds were patented in England and France before the middle of the last century; but none was of any great value until that invented by Elias Howe in 1845, and patented by him in 1846. Elias Howe was an American, the son of a miller of Spencer, Massachusetts. He was a poor boy and had nothing when he made his invention. He had great trouble with it at first because others stole his patents; but he afterwards defeated them in the courts and received a large fortune from his royalties.

Howe's invention contained the eye-pointed needle, the lock stitch, and the automatic feed. As soon as it was shown to be a success, other Americans began to add improvements to it. Among the first of these were John Bachelder, Allen B. Wilson, and Isaac M. Singer. Wilson invented the feed plate now used on almost all machines, and Singer, among other things, the overhanging arm which holds the vertical needle, and also the treadle which enables the machine to be worked by the feet, all of the machines before that time having been moved by a crank turned by the hand. We now make many improved machines turned by hand, and export them to all parts of the world.

44. OUR GREAT CLOTHING FACTORIES

WE are now at the end of our travels through the world of clothing. We have gone to the different parts of the globe where the most important materials we wear have their origin; and have seen some of them made into the articles which we daily use to protect us from the weather or for personal adornment. We have traced the various fibers and other materials into the making of cloth, and have now only to see the goods cut and sewed into wearing apparel.

This is a great industry of itself, and especially so in a rich country like ours. We have tens of thousands of tailors and dressmakers, who labor in small shops and do much of their work with their hands. We use also a vast deal of clothing which is made by ourselves at our homes. Sewing and dressmaking are taught in our schools. Moreover, there are great factories devoted to producing clothing ready-to-wear, and these employ hundreds of thousands of men, women, and children.

Who manufactured the first suit of man's clothing, we do not know. The Bible says that Adam and Eve "sewed fig-leaves together and made themselves aprons" and a little farther on it relates that the Lord gave them "coats of skins and clothed them." After that, such garments as man wore were made either by himself or by the female members of his family; and this condition probably continued until he was enough civilized to have cities and towns. Then the tailoring industry became important; and from that time until now there have been tailors in

every civilized center. We find them mentioned in history again and again; and they are referred to even in our nursery tales. Shakespeare, for instance, in "Othello," allows one of his characters to sing an old nursery song about a tailor: —

> "King Stephen was a worthy peer,
> His breeches cost him but a crown;
> He held them sixpence all too dear,
> With that he called the tailor lown."

This is far different to-day. Our tailors receive good prices for their labor, and they make the best and finest of our garments.

At the same time, the business which they did in the past has fallen off, owing to the new methods of making ready-made clothing and the employment of many men in factories, where much of the work is done by machinery. In our colonial times all garments were cut out and sewed together either in small tailor shops or at home. Now the greater part of the clothing worn by men, women, and children is made in factories by machinery. Out of every ten men and boys in our country, nine wear ready-made garments, and the establishments from which they come have an annual product worth almost one billion dollars. Our clothing industries paid out in wages, during the year of the last census, almost one hundred and ninety million dollars; and they had in their employment more than five hundred thousand men, women, and children. This is a mighty army. It is the great army of clothes makers whose spears are needles, whose swords are scissors, and whose Gatling guns are rattling sewing machines.

It was the invention of the sewing machine, along about 1850, that formed the real beginning of this industry. The tailors then found that they could work much faster; and that it paid them to produce clothes in quantity rather than suit by suit to order. Along about ten years later our Civil War broke out, and the government needed uniforms at once for its army, which soon numbered

In a clothing factory

hundreds of thousands of men. The demand was so great that factories were established to supply it, and the ready-made clothing business became one of the chief industries of the United States. Since then it has steadily increased, and now the most of our clothing is manufactured in that way.

In this great industry the work is far different from that of the small tailor or dressmaker. In the latter, one man or woman may cut out and sew up a whole suit. In

the factories a dozen different persons are employed upon one garment. Each worker does but one thing over and over, day after day. The designer makes the patterns, the cutter shapes a half-dozen or more coats, vests, or trousers at a time, and several tailors sew away, each on one part of the same garment and on nothing else. Then there is a class of men who make only buttonholes, vest makers who sew only vests, coat makers who sew only coats, and trouser makers devoted to trousers.

Moreover, there are some establishments which produce only one kind of garment; so that a coat many come from New York, a pair of trousers from Philadelphia, and a vest from Boston, all to be sold as one suit. Such factories usually have a common head; and, after the several garments are done, they are sent there to be assembled into suits, ready for sale as such to the wholesale and retail trade.

Much of the finishing of our ready-made clothing is done in the homes of the workers by the piece, and often by the task. In the task system a certain number of garments are counted as the work of one day, no matter how long the laborer spends upon them. The factories classify men's and children's clothing as coats, vests, trousers, short trousers, and children's coats. At one time a task consisted of the sewing of only eight or nine coats a day. Then the contractors, pretending that times were hard, gradually added coat by coat to the task, until twenty coats were required to make a day's work, and the laborer had to sew away twenty or more hours to finish them. This method of getting more than a just amount of work out of the men is called "sweating." It still pre-

vails in some of our cities, although it is much less common now than it was in the past.

But let us take a look at one of the great factories which produce men's and boys' ready-made clothing. We shall choose one where the garments are all manufactured under one roof, and where the workmen are well paid and well treated. The establishment is situated in Philadelphia, a city in which upwards of twenty million dollars' worth of such clothing is made every year.

We first enter the rooms where the piece goods are brought in, fresh from the woolen mills. We watch the inspectors look over them to see that they are of just the right quality; and then go on to the shrinking department, where the goods are treated to a bath of cold water or steam and hung up to dry. This is in addition to the shrinking they have in the mills, and it is to insure that they will not change after they are made into clothes. After shrinking, they are re-finished by pressing them with heavy weights; and are then ready to be cut up for clothing.

The cutting is interesting. Each garment requires just so many pieces. There are sixteen separate parts for a coat, ten for a vest, and seven for a pair of trousers; or thirty-three different pieces for a whole suit of clothing. A dozen or so of each kind of pieces is cut at one time. We see a man lay the cloth upon tables, one piece on top of another, until a thickness of twenty-four pieces is reached. Then he takes a pasteboard pattern, made by the designer, of the shape of the part to be cut from the cloth. He places this on the top of the pile, and draws a piece of French chalk carefully around it, leaving an outline.

Now the cutting begins. This is done with a little circular saw. It makes forty revolutions a second, and goes so fast we cannot see it move. The workman directs it with his hand along the lines of the pattern; and it cuts through the two dozen thicknesses as though they were butter and the knife were red hot. In less time than it takes to tell it, we see twenty-four pieces of a coat pattern made; and, going to other cutters, watch the several parts of vests and trousers sliced out, two dozen at a time, and all as accurately cut, as with a pair of shears moved by hand.

After the pieces are cut, they are tied up in bundles with the proper linings and buttons, and are then sent to the tailoring floor overhead. Here the various parts are put together by skilled workmen, each of whom has his specialty. The buttonholers have machines which make seven buttonholes every minute; and each class of sewers has special machinery which aids it in doing the work in the cheapest and quickest possible manner. When the garments have been sewed, they are heavily pressed to keep them in shape, and, in this factory, the best of them are fitted upon men and boys to see that they are just right. Our factory makes all sizes of clothing; and it takes boys of all ages to try on the suits. After the fitting, the garments are carefully folded and packed up to be shipped to the stores.

The manufacture of women's suits and cloaks is carried on in much the same way; each kind of garment having some special treatment of its own. In most such establishments the winter clothes are made in the heat of the summer; and those of light stuffs for hot weather while the ground is covered with snow.

In addition to these works for making suits for men, women, and children, we have more than two thousand devoted to shirt waists for women and girls; and in other factories, in the year of the last census, we manufactured more than ten million shirts for men and boys. We then made over twenty-one million collars and cuffs, as well as a vast deal of underclothing, all of which were produced by machinery in factories especially equipped for the purpose.

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